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THE PLANT DISEASE BULLETIN

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THE PLANT DISEASE SURVEY

16.

SUPPLEMENT 15

Diseases of Cereal and Forage Crops in the United States in 1920

May 1, 1921

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1920

G. R. Lyman, Pathologist in Charge.

R. J. Haskell, Asst. Pathologist. G. H. Martin, Jr., Asst. Pathologist.

List of Collaborators of the Plant Disease Survey who have made the principal contribution to the 1920 annual Summary.

Alabama........	Prof. A. F. Thiel
Arizona........	Prof. J. G. Brown
Arkansas.......	Dr. J. A. Elliott
	Prof. H. R. Rosen
Colorado.......	Prof. C. D. Learn
Connecticut....	Dr. G. P. Clinton
Delaware.......	Dr. T. F. Manns
Georgia........	Prof. J. A. McClintock
Idaho..........	Prof. C. W. Hungerford
Illinois.......	Dr. H. W. Anderson
	Dr. F. L. Stevens
	Prof. G. H. Dungan
Indiana........	Dr. M. W. Gardner
Iowa...........	Dr. I. E. Melhus
Kansas.........	Prof. L. E. Melchers
Kentucky.......	Dr. W. D. Valleau
Louisiana......	Dr. C. W. Edgerton
Maryland.......	Prof. C. E. Temple
Massachusetts.	Prof. A. V. Osmun
	Mr. W. S. Krout
Michigan.......	Dr. E. A. Bessey
	Dr. G. H. Coons
	Mr. Ray Nelson
Minnesota......	Dr. E. C. Stakman
	Prof. J. G. Leach
Mississippi....	Prof. D. C. Neal
Missouri.......	Dr. E. F. Hopkins
Montana........	Prof. D. B. Swingle
	Dr. H. M. Jennison
Nebraska.......	Prof. R. W. Goss
Nevada.........	Prof. C. W. Lantz
New Hampshire..	Dr. O. R. Butler
New Jersey.....	Dr. M. T. Cook
New York.......	Dr. Chas. Chupp
North Carolina.	Dr. R. A. Jehle
North Dakota...	Prof. H. L. Bolley
	Dr. Wanda Weniger
Ohio...........	Prof. A. D. Selby
	Mr. R. C. Thomas
Oregon.........	Prof. H. P. Barss
	Prof. C. R. Orton
Pennsylvania...	Prof. H. W. Thurston
Porto Rico.....	Mr. Julius Matz
South Dakota...	Dr. Arthur T. Evans
Tennessee......	Prof. S. H. Essary
	Dr. L. R. Hesler
	Prof. C. D. Sherbakoff
Texas..........	Dr. J. J. Taubenhaus
Utah...........	Dr. B. L. Richards
Vermont........	Dr. B. F. Lutman
	Prof. A. H. Gilbert
Virginia.......	Dr. F. D. Fromme
Washington.....	Dr. F. D. Heald
	Mr. B. F. Dana
	Mr. A. M. Frank
West Virginia..	Dr. N. J. Giddings
	Prof. Anthony Berg
	Dr. J. L. Sheldon
Wisconsin......	Dr. R. E. Vaughan

DISEASES OF CEREAL AND FORAGE CROPS
IN THE UNITED STATES IN 1920

Prepared by

F. D. Fromme,
Collaborator with the Plant Disease Survey and
Plant Pathologist at the Virginia Agricultural Experiment Station.

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Introductory Statement

As usual the collaborators of the Plant Disease Survey have furnished the greater part of the information upon which this summary is based. The names of those who furnished most of the state reports and who thus helped to make this summary a success are listed on the opposite page. It should be remembered, however, that their reports were made possible through the cooperation of other collaborators, pathologists, volunteer reporters, and others whose names may not be mentioned here, but to whom credit is due.

There was no cereal disease survey in 1920 and so no data from that source were available as was the case last year. However, the results of the 1919 cereal survey have been studied further with reference to loose smut of wheat and some interesting data on varietal susceptibility are given in connection with the summary of that disease.

Another very important source of information has been data furnished by members of the U. S. Department of Agriculture Office of Cereal Investigations. Many of these data have appeared in the Cereal Courier, the news letter of the Cereal Office.

In preparing this summary it has been kept in mind that many of the facts regarding cereal diseases are too well known to need repetition. Thus the geographic range of the commoner troubles has already been fairly well outlined and so it is only when new or significant occurrences are reported that particular mention is made of them.

DISEASES OF CEREAL CROPS

During the year 1920 cereal crops in general probably suffered much less from disease than the previous year, which as far as cereal diseases were concerned, was an exceptional one. It is true that some of the spring wheat states experienced a very severe epiphytotic of stem rust and although the disease caused heavier losses in these particular states than in 1919, the total loss for the country was somewhat smaller. Scab of small grains, a disease which for the past few years has been taking enormous tolls from the nations crop, and has ranked along with stem rust in destructiveness, was noted for its absence in 1920 causing about 1% loss as compared with 5 1/4% in 1919. All of the other diseases of the small cereals, with the exception of spot blotch of barley, and crown rust of oats, seemed to be either subnormal or normal in severity.

WHEAT

Bunt caused by Tilletia laevis Kühn and T. tritici (Bjerk.) Wint.

The occurrence and losses due to bunt of wheat were as a rule about the same in 1920 as in 1919. It was in general more prevalent and severe in states west of than in those east of the Mississippi River. Bunt was epidemic in Kansas, more than last year in Arkansas, and prevalent throughout the whole wheat growing district of Washington and Oregon. Wisconsin reports much less than in 1919, it was also unusually slight in Virginia, and less than last year in North Dakota. It was said in Indiana to be worse in the northern third of the state and to occur with threshing rings, in Utah to be severe only in certain localities, in Idaho to be more severe in the northern section (4% average) than in the southern (1% average), and in Oregon it was somewhat worse than last year owing to heavy soil infection in the Willamette Valley. The following statements with refer- to severity of bunt are of interest:

> Michigan: "Stinking smut (T. laevis) was less than any time in my ten years in the state. I attribute this to the exceptionally fine growth of winter wheat in the fall of 1919. I would place the loss in general at about 3% of the crop. Any fairly clean grain came through with but slight smut." (G. H. Coons)

> Kansas: "By far the greatest epidemic of bunt in many years struck Kansas the past season. No records available show that it has ever been as prevalent. Many fields showed as high as 40 or 50% of smut. Two of the worst counties in the state were Rice and Barton. Many others throughout the hard winter wheat district showed all the way from a trace to 20% infection." (L. E. Melchers in Cereal Courier 12: 329. Sept. 30, 1920.)

Bisby reports only a little bunt found in Manitoba and all of it was T.

tritici. He states that treatment of seed with formaldehyde is general.

The occurrence and estimated percentages of loss are shown in the accompanying map and also in the following tabulation. The losses in bushels will be given in Plant Disease Bulletin, Supplement 18, 1921.

Table 42. Percentage loss from bunt of wheat - 1920.

Per cent loss	States
5	Kansas.
3	Arkansas, Michigan.
2	West Virginia, North Carolina, Idaho, Washington, Oregon, California, Arizona.
1	New Jersey, Delaware, Maryland, South Carolina, Georgia, Alabama, Tennessee, Missouri, Nebraska, Oklahoma, Colorado, Utah, Nevada.
.5	Virginia, Ohio, Kentucky, North Dakota, Iowa, South Dakota, Texas.
.3	Indiana.
t	New York, Pennsylvania, Illinois, Wisconsin, Minnesota.

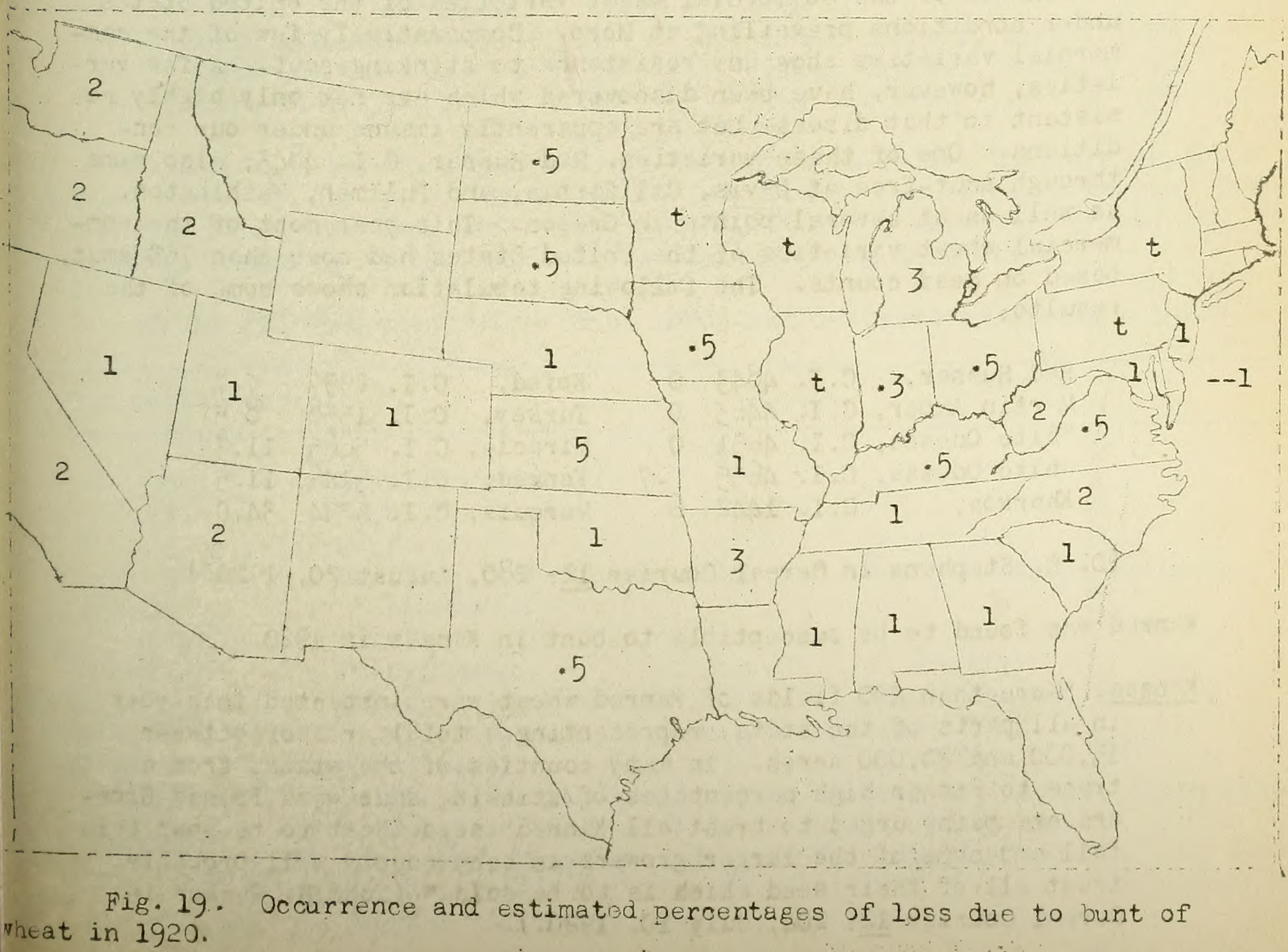


Fig. 19. Occurrence and estimated percentages of loss due to bunt of wheat in 1920.

Considerable progress has been made in the experimental testing of varieties as to relative susceptibility in California and Oregon as reported in the Cereal Courier.

California: "Smut counts have been completed at Davis on 1919 sowings. The counts consisted of both smutted plants and smutted heads. In many rows all the plants were smutted but some smut-free heads always appeared. No significant differences were noted between the early November and the mid-December dates of sowing smutted varieties. There were many varieties only slightly smutted but the following were found immune from bunt (*Tilletia tritici*):

Martin Amber,	C.I. 4463	Turkey Red,	C.I. 1558
Red Hussar,	C.I. 4843	Crimean,	C.I. 3055
Wash. hybrid,	C.I. 330	Khapli emmer,	C.I. 4573
Wash. hybrid,	C.I. 332	Khapli emmer,	C.I. 4013

Smut counts on 576 surviving plant experiments with 40 varieties gave some very resistant survivals and one immune selection." (W. W. Mackie in Cereal Courier 12: 262-263, August 10, 1920.)

Oregon: "Mr. Woolman has completed making smut counts in the cereal disease nursery. Two years' data are now available on the smut resistance of the commercial wheat varieties of the United States under conditions prevailing at Moro. Comparatively few of the commercial varieties show any resistance to stinking smut. A few varieties, however, have been discovered which are not only highly resistant to that disease but are apparently immune under our conditions. One of these varieties, Red Hussar, C.I. 4843, also came through smut-free at Davis, California, and Pullman, Washington, as well as at several points in Oregon. This year most of the commercial wheat varieties of the United States had more than 75% smut, based on head counts. The following tabulation shows some of the results:

Red Hussar,	C.I. 4843	0	Kofod,	C.I. 2997	7.7
Martin Amber,	C.I. 4463	0	Turkey,	C.I. 1558	8.5
White Odessa,	C.I. 4651	0	Miracle,	C.I. 5665	11.3
White Odessa,	C.I. 4655	.7	Kanred,	C.I. 5146	11.5
Kharkov,	C.I. 1442	6	Marquis,	C.I. 5294	34.0

(D. E. Stephens in Cereal Courier 12: 280, August 20, 1920.)

Kanred was found to be susceptible to bunt in Kansas in 1920.

Kansas: "More than 400 fields of Kanred wheat were inspected this year in all parts of the state, representing a total area of between 15,000 and 20,000 acres. In many counties of the state, from a trace to rather high percentages of stinking smut were found. Growers are being urged to treat all Kanred seed wheat to be sown this fall and some of the larger growers in each county will probably treat all of their seed which is to be sold." (John H. Parker in Cereal Courier 12: 204, July 10, 1920.)

Temple states that Leaps Prolific appears to be resistant to bunt (T. laevis) in Maryland, while Fultz is very susceptible.

The general practice of seed treatment is considered to be the important factor in the reduction in severity of bunt losses by several collaborators. A new and promising method of seed treatment for the prevention of bunt has been reported by Mackie and Briggs from California (Chemical dusts for the control of bunt. Phytopath. 11: 38. January, 1921). They report good results from the use of a mixture of copper sulphate and calcium carbonate (1-1), and of copper carbonate. These dusts were used at the rate of 2 ounces per bushel.

Temple states that the dry formaldehyde treatment has caused seed injury in Maryland and that it is not so effective as either the formaldehyde dip or sprinkle.

Loose smut caused by Ustilago tritici (Pers.) Jens.

Loose smut occurred to some extent in practically all wheat fields throughout the country, but varied greatly in severity in different sections. It was again more severe in the South Atlantic division (Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia) as a group than any other, and was a factor of importance in all states east of the Mississippi River with but few exceptions. West of the River the losses did not exceed 1% on the average except in the states of Arkansas, Texas, and Idaho. The average losses for the separate divisions are estimated as follows:

North Atlantic	2.1%	North Central, East	1.7%
South Atlantic	3.2%	North Central, West	.7%
South Central	1.7%	Far Western	.7%

Losses were somewhat greater as a rule than in 1919. They are reported as more severe in New York, Pennsylvania, New Jersey, Tennessee, Arkansas, Illinois, Texas, and Idaho, and less severe in Virginia, Georgia, Oklahoma, and Kansas. The percentage losses by states are shown in the following tabulation:

Table 43. Percentage loss from loose smut of wheat by states - 1920.

Per cent loss	States
5	West Virginia.
4	North Carolina.
3.5	Maryland.
3	New York, New Jersey, South Carolina, Tennessee, Illinois, Arkansas.
2.8	Virginia.
2.5	Pennsylvania.
2	Vermont, New Hampshire, Georgia, Massachusetts, Delaware, Alabama, Ohio, Indiana, Texas, Idaho.
1.5	Mississippi.
1	Maine, Connecticut, Michigan, Kentucky, Missouri, South Dakota, Nebraska, Oklahoma, Colorado, Utah, Arizona.
.5	Wisconsin, Minnesota, Kansas, Washington, Iowa.
.1	North Dakota.
t	Oregon, California, Nevada, New Mexico, Louisiana.

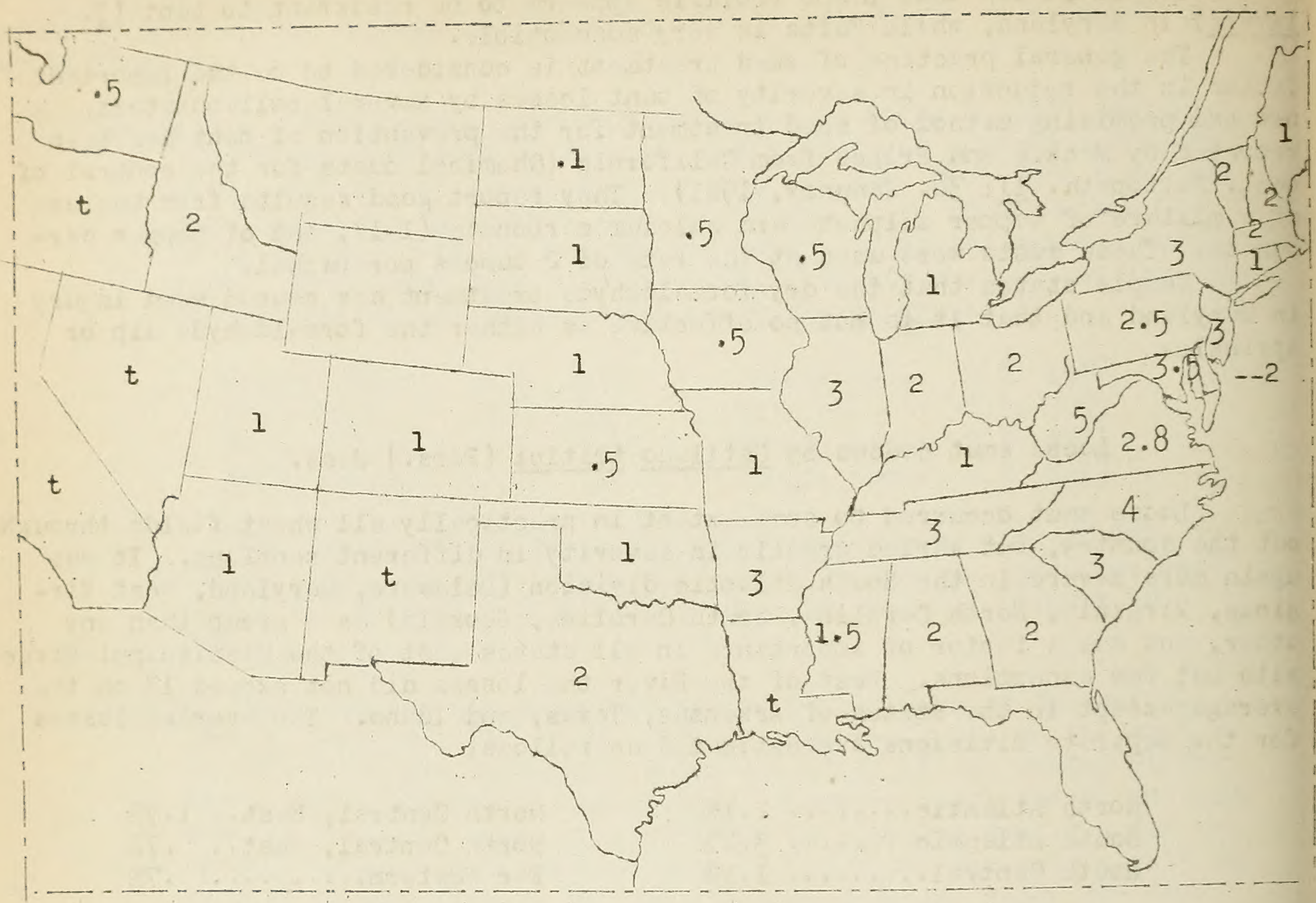


Fig. 20. Percentage loss from loose smut of wheat, 1920.

A special question on the extent of winter killing in wheat was asked of collaborators with the view of correlating, if possible, variations in the occurence of wheat diseases with winter killing. The following note on the variation,ascribed to winter killing, in the percentage of loose smut of wheat was supplied by Fromme:

> Virginia: "Winter killing of wheat was general throughout the state but especially severe in the higher altitudes of southwestern Virginia. At Blacksburg on soil of good fertility the percentage of winter killing was 27%, while on very poor soil it was very near 100%. I believe that winter killing tends to lower the percentage of loose smut, probably the affected plants succumb more readily to winter injury. The general lowering of the percentage of loose smut in the state would confirm this as does the following data. In connection with hot water seed treatments in the Shenandoah Valley, which were made in cooperation with the Cereal Office, samples of treated and untreated grain from each lot were planted at Blacksburg as a check on the field results. These were in rod rows, six rows to each lot. There was little winter killing in the fields in the Shenandoah Valley except in one (No. 2), and about 30% on the average at Blacksburg. The percentage of loose smut in the untreated wheat from the two stations was as follows:

Lot number	1	2	3	4	5	6
Shenandoah Valley	5	.2	3	3	4	3
Blacksburg	2	.3	.9	.5	.9	.6"

Coons has previously stated that wheat affected with loose smut seems more likely to succumb to winter killing than healthy wheat (Phytopath. 8: 70, 1918). He makes the following comment in 1920:

> "Winter injury commonly culls out affected wheat, reducing loose smut to a trace (as average). This year,with better snow covering,the loss in some fields reached 5%."

Winter injury (1919-20) was reported by collaborators as follows: Slight - Delaware, Georgia, Michigan, Wisconsin, and Washington. Severe - Virginia (30%). Ohio (20%), North Dakota, and Tennessee. Minnesota 25-30%, but not as serious as usual.

Table 44. Summary of cereal disease survey data in 1919 with respect to occurrence of loose smut in certain varieties of wheat, as shown in Table 45.

Variety	Total No. fields inspected	Total No. fields smutted	Per cent fields smutted	Highest % smut found	Average % smut in smutted fields
Stoner	68	58	88	15	3.6
Michigan Amber	45	38	84	15	2.8
Red Wave	193	169	88	20	2.7
Poole	186	157	84	15	2.4
Rudy	44	34	77	12	2.3
Dicklow	55	50	91	10	2.2
Turkey Red	257	217	82	15	2.1
Red Cross	58	41	71	20	1.3
Fultz	211	155	73	15	1.3
Fulcaster	147	129	88	10	1.1
Red Chaff	16	11	68	6	1.1
Red Rock	29	22	76	6	.9
Red May	39	25	64	8	.9
Marquis	91	39	43	2	.3
Leap's Prolific	24	20	83	2	.1

It is probable that winter injury, choice of varieties, and soil fertility are all factors of importance in determining the relative prevalence of loose smut in different sections.

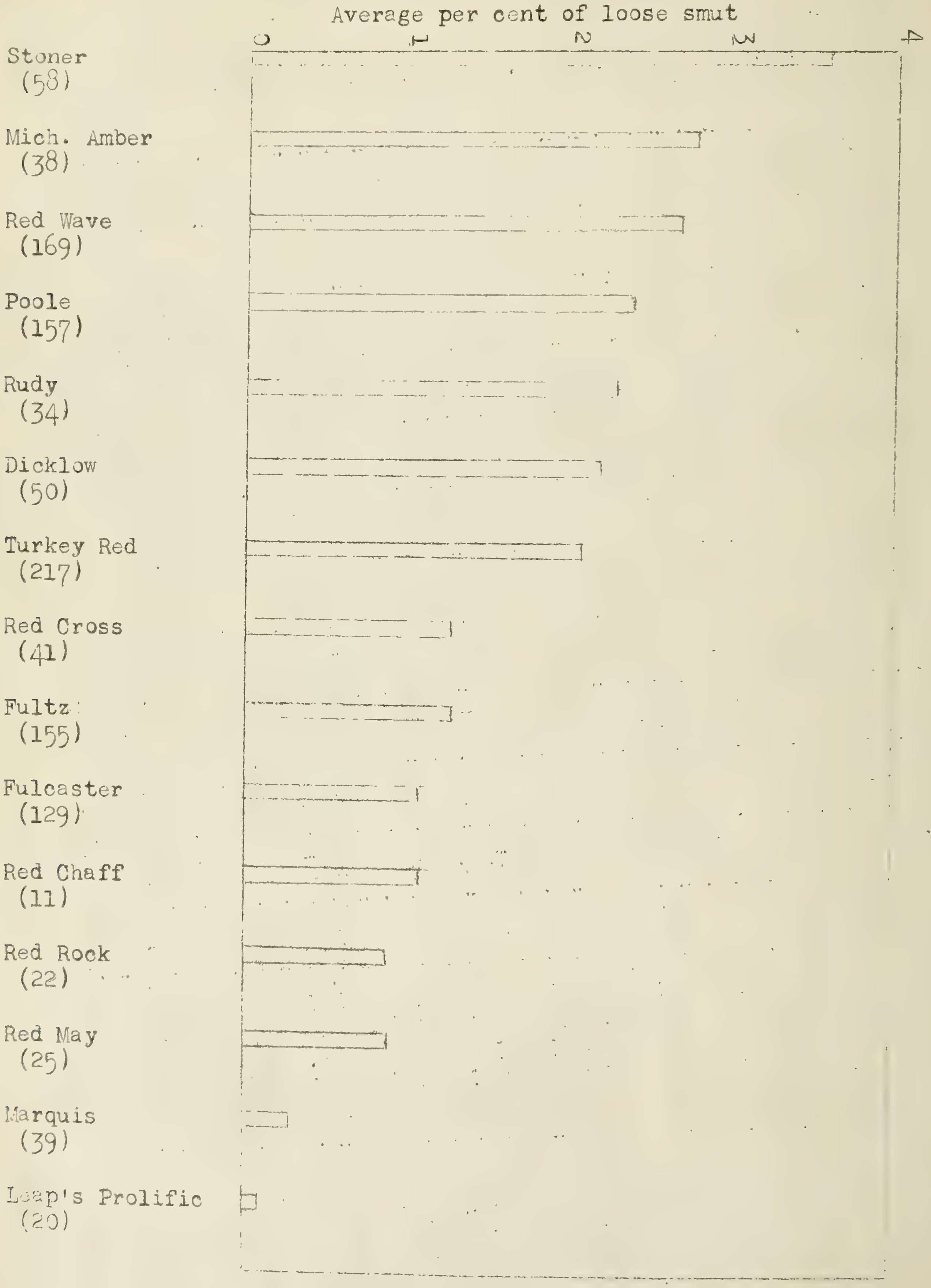
Notes on varietal susceptibility were received from two collaborators. Hungerford states: "In south Idaho the Dicklow wheat, which is the most popular and highest yielding wheat for the irrigated regions, has proven very susceptible to loose smut." Fromme notes that Leap's Prolific appears to be resistant or disease escaping in Virginia, while Stoner and Fulcaster are especially susceptible. Coons has previously shown apparent marked differences in the susceptibility of Shepherd's Perfection and Goings, the latter being much more susceptible than the former. A summary of the cereal disease survey data for 1919 from the standpoint of range and severity of infection in some of the varieties commonly grown in the states where loose smut is common is shown in the following table:

Table 45. Susceptibility of wheat varieties to loose smut as shown by summary of 1919 cereal disease survey records for Pennsylvania, Maryland, Virginia, Kentucky, Tennessee, Georgia, Alabama, Texas, Oklahoma, Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, and Idaho. Upper figure in each percentage column represents the number of fields, lower figure the percentage of fields affected.

Variety	States	Percentage of loose smut															
		0	t	.5	1	2	3	4	5	6	7	8	9	10	12	15	20
Fulcaster	Ala., Ky.,	18	49	13	37	15	5	5	1	3				1			
	Md., Mo.,		38	10	29	11	4	4	1	2				1			
	Ohio, Okla.																
	Pa., Tenn.,																
	Texas.																
Fultz	Ky., Md.,	56	47	10	53	24	10	5	3	1		1				1	
	Mo., Ind.,		30	6	34	16	6	3	2	1		1				1	
	Ohio, Pa.,																
	Tenn.																
Poole	Ind., Ky.,	29	27	8	39	33	17	11	7	4		5		3	1	2	
(Gill)	Tenn.,Ohio,		17	5	25	21	11	7	4	3-		3		2	1-	1	
(Harvest King)	Md.																
Stoner	Ky., Md.,	10	14	1	6	6	9	2	4	3	5	5		1		2	
(Miracle)	Ohio, Okla.		24	2	10	10	16	3	7	5	9	9		2		3	
(Marvelous)	Tenn., Va.																
(Three Peck)																	
Michigan Amber	Ind.	7	9	4	6	6	2		5	3				1	1	1	
			23	10	16	16	5		13	8				3	3	3	
Red Chaff	Ky., Ind.	5	4	2	3	1				1							
			37	18	27	9				9							
Red Rock	Ind., Ohio,	7	10	1	7	2	1			1							
	Mo.		45	5	31	9	5			5							

Variety	States	Percentage of loose smut															
		0	t	.5	1	2	3	4	5	6	7	8	9	10	12	15	20
Red Wave	Ind., Ill., Ky., Md., Mo., Ohio, Pa.	24	35 20	14 8	37 22	26 15	12 7	11 6	14 8	5 3	1 1	3 2	1 1	5 3	1 1	1 1	3 2
Rudy	Ind., Va.	10	7 20	2 6	8 23	6 18	4 12	3 9	2 6					1 3	1 3		
Turkey Red	Ind., Ill., Ia., Kans., Ky., Mo., Idaho, Ohio Okla., Tex.	40	65 30	8 4	57 26	32 15	10 5	9 4	5 2	14 6	1 1-	7 3		5 2	2 1	2 1	
Red May	Tenn., Ky., Ga., Mo.	14	11 44	5 20	5 20	2 8		1 4				1 4					
Leap's Prolific	Pa., Md., Va., Tenn.	4	18 90		1 5	1 5											
Marquis	Ida., Ill., Ind., Ia., Ohio.	52	27 69	6 15	5 13	1 3											
Dicklow	Idaho.	5	14 28		15 30	5 10	2 4	5 10	3 6	3 6	1 2	1 2		1 2			
Red Cross	Ill., Ind., Mo.	17	24 58	3 7	6 15	3 7	1 2		2 5	1 2							1 2

Fig. 21. Summary of cereal disease survey data in 1919 with respect to the occurrence of loose smut in certain varieties of wheat. (Figures in parentheses show number of fields.)



The status of the hot water treatment for loose smut.

Information received in response to a special question addressed to collaborators indicates that the economic importance of loose smut is becoming more generally recognized and that demonstrations for its control are being conducted in several states. The practice is becoming well established in Indiana where eight counties have central treating plants according to Gardner and Jackson. The plan of the central treating plant is also being pushed in Virginia and Idaho and demonstrations with this end in view are evidently being conducted in several other states. All reports indicate that the treatments have been efficient and generally satisfactory.

Pennsylvania: "Nine demonstrations of hot water treatment for loose smut of wheat and barley were given last year. The results were 100% control vs. 10-20% infection in the checks. We have given seven demonstrations this fall. To our knowledge the sixteen demonstrations treated all the wheat that was ever treated in the state." (Nixon.)

Maryland: "The modified hot water treatment gives us almost perfect control. We recommend the use of a seed plot, planted with treated seed." (Temple)

Virginia: "Six demonstrations of the hot water treatment were made in the fall of 1919. The percentages of control obtained in the different fields were as follows: 96.3, 99.1, 90.1, 91.2, 95.0, 86.6. Smut percentages in the checks were as follows: One field .2, three fields 3, one 4, and one 5%. Yield data were obtained in one test, the treated seed yielding at the rate of 27 bushels per acre and the untreated 16. Three central treating stations have been established as a result of these demonstrations." (Fromme)

West Virginia: "Hot water treatment tested in five fields, absolute control in treated plots. Untreated - two fields 1-3%, two fields 5-6%, one field trace." (Giddings)

Arkansas: "Results of hot water treatment good, but not in general use." (Elliott)

Ohio: "The hot water treatment has been very satisfactory as practiced here during the last two seasons. In the season of 1919 I think there was much more application of the treatment than in 1920." (Selby)

Illinois: "There is practically no hot water treatment for loose smut of wheat made in this state. I have treated one batch of seed for a farmer in Warren County, but other than this we have not used this method of smut prevention." (George H. Dungan)

Idaho: "This year demonstrations were put on in several counties by the Extension Division. Small amounts of wheat were brought in by farmers to one central place and there treated under supervision. The results have been very satisfactory. Very little injury resulted and satisfactory control of the smut was secured. It is planned to extend this work very materially next year." (Hungerford)

Manitoba: Loose smut occurred commonly in wheat from a trace to about 1% or occasionally more. In certain cases it may become necessary to make arrangements for treating by the hot water method, or for the discarding of seed lots more seriously affected." (Bisby)

On the basis of the results of the work in Indiana it would seem probable that the hot water treatment would be commercially profitable in those states in which the average percentage of loose smut equals or exceeds that of Indiana.

Flag smut caused by Urocystis tritici Koern.

Flag smut which was reported for the first time in the United States in 1919 occurred again and over a slightly wider area in 1920. It is still restricted, so far as is known, to the district around Granite City, Illinois, where it was first reported. It was found in 1919 in 33 fields comprising about 825 acres, but a survey made in 1920 by the Cereal Office in cooperation with the University of Illinois showed the disease to be present in 111 fields comprising about 2,500 acres and confined to an area of about 47 square miles. These data together with those which follow are taken from a report by George M. Reed in the Cereal Courier 12: 242, July 31, 1920. Infection was not severe in most fields, only a trace being found, but in a few places as many as 20-25% of the stalks were found infected. Practically no grain was produced on affected stalks and less than 1% of the affected stalks produced heads. Evidence of soil infestation was obtained by sowing clean seed on land that has borne an infected crop in 1919, which resulted in a small percentage of infected plants. It was also found that the date of seeding was of importance in determining the amount of infection, the worst infection being found in the earliest sowings, October 7 and 8. Seed sown November 17 and 18 did not germinate until spring but came up well and was free from infection. Marked differences in susceptibility were found in both field and greenhouse sowings which are tabulated as follows:

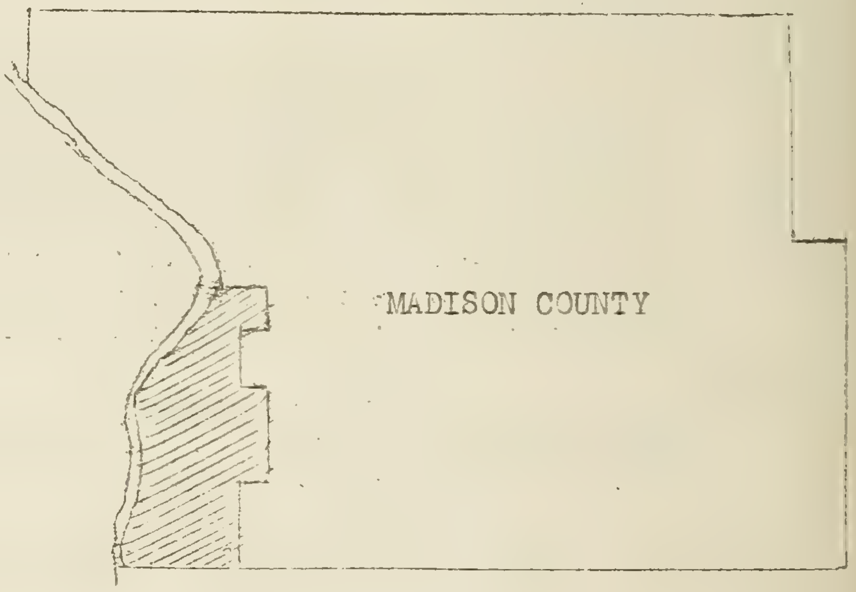


Fig. 22. Madison County, Illinois showing area quarantined for flag smut of wheat.

Field experiments

Most susceptible

Dawson
Dawson Golden Chaff
Fultz
Jones Winter Fife
K. B. No. 2

Leap
Mealy
Purple Straw
Red Cross (Salzer's Prizetaker)
Rocky Mountain

Slight infection, very slight in most.

Acme
Bearded Purple Straw
China
Currell Prolific
Dietz
Gypsy
Illini Chief
Kanred
Lancaster
Missing Link
Nebraska Hybrid No. 28.
Poole
Red Rock
Red Wave
Treadwell

No infection

American Bronze
Fulcaster
Imperial Amber
Indiana Swamp
Mammoth Amber
Martin Amber
Red May
Theiss

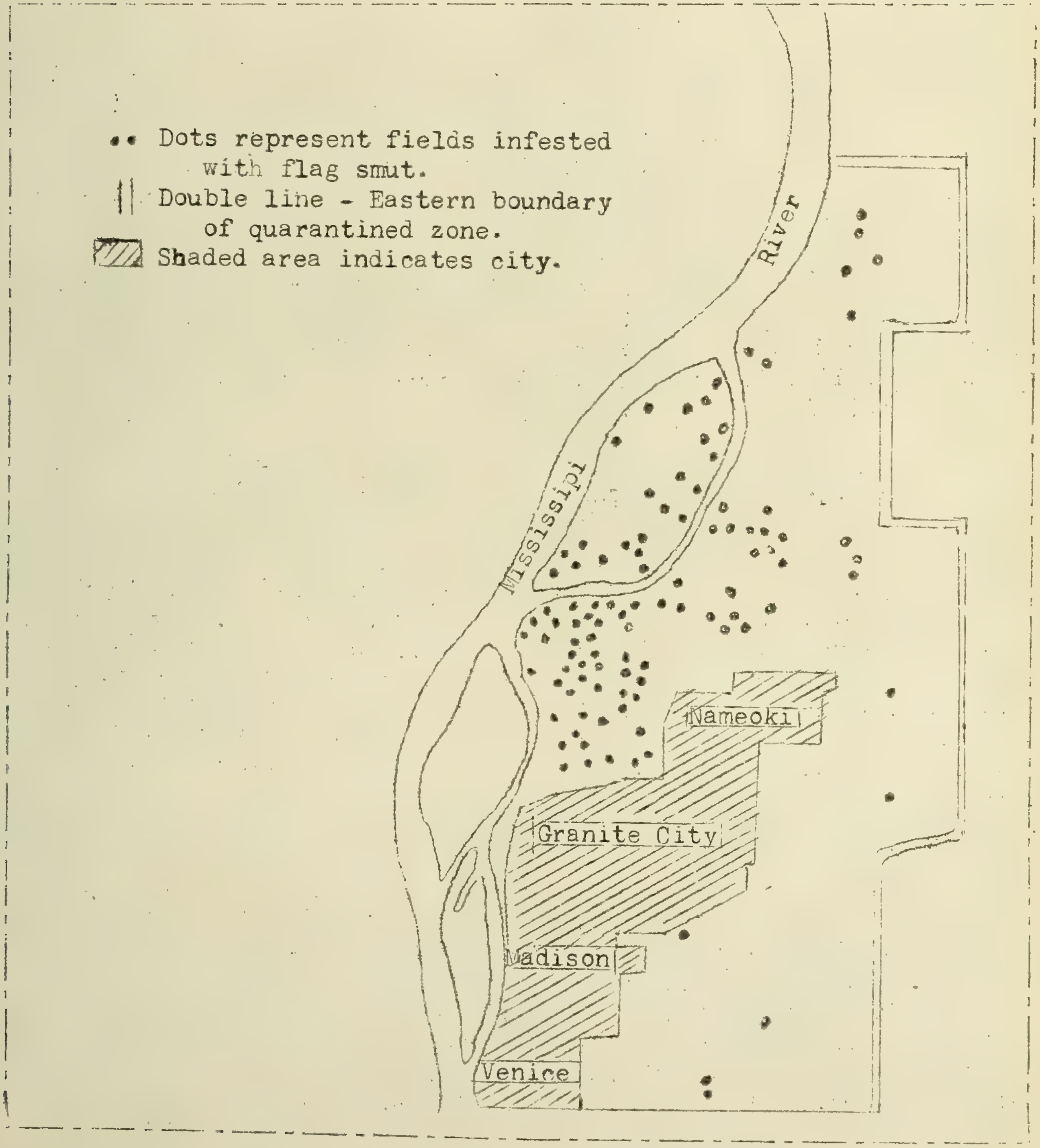

•• Dots represent fields infested with flag smut.
‖ Double line - Eastern boundary of quarantined zone.
▨ Shaded area indicates city.
Missisipi
River
Nameoki
Granite City
Madison
Venice

Fig. 23. Quarantined area in Madison County, Illinois - 1920.

Greenhouse experiments
(Figures are percentages of plants infected)

Bobs	95.3	Mealy	2.2
Cowra	92.6	Bunyip	2.
White Federation	90.9	Little Club	2.
Defiance	88.3	Cedar Comeback	0
Red Cross	85.4	Early Defiance	0
Salzer's Prizetaker	75.7	Florence	0
Hard Federation	72.5	Fulcaster	0
Fultz	47.5	Galgalos	0
Early Baart	35.5	Poole	0
Marquis	7.8	Red Rock	0
Kanred	5.4	Red May	0
White Australian	4.1		

Measures which are in operation are planned to accomplish both control and eradication. These consist of (1) quarantine of the infested area; (2) treatment of grain with formaldehyde (1 lb. to 25 bushels) as it comes from the separator; (3) burning of all straw in the quarantined area; (4) avoidance of infested fields for wheat growing; (5) use of seed wheat from non-infested localities; (6) treatment of all seed wheat with the copper sulphate and lime dip; and (7) use of resistant varieties.

The treatment of seed wheat in this area has been placed on a practicable basis by the establishment of a central treating plant in Madison County, in which approximately 15,000 bushels were treated by the copper sulphate and milk of lime method in the fall of 1920. The plant in question has a maximum capacity of approximately 1,000 bushels a day.

Stem rust caused by Puccinia graminis Pers.

Stem rust was very prevalent and destructive in the spring wheat sections of the upper Mississippi Valley. The epidemic exceeded in severity that of 1919 in the states of North Dakota, South Dakota, Minnesota, Nebraska, and Wisconsin, while it was markedly less severe in Kansas, Missouri, and other winter wheat states which border on the spring wheat belt. Infection was slight as a rule with average losses not exceeding a trace in the Atlantic States with the exception of West Virginia and Georgia. In all of the winter wheat states of the Mississippi Valley, rust was of slight importance,as a rule, but Tennessee reports severe local attacks with an estimated reduction in yield for the state as a whole of about 2%. The disease was recorded as occurring in all of the far western states where losses were slight except in Utah and Arizona. B. L. Richards reports stem rust as general in the irrigated districts of Utah, attacking 50% of plants and causing approximately 5% loss for the crop as a whole. The accompanying map shows the occurrence of stem rust and the estimated percentages of reduction in yield in 1920 by states. The complete data on losses will be found in Plant Disease Bulletin, Supplement 18, 1921.

The fact that losses were restricted almost entirely to spring wheat is shown in the reports of the Bureau of Crop Estimates which show a shrinkage of 61,990,000 bushels in spring wheat from the July 1 estimate to the final production as recorded in December, whereas the yield of winter wheat exceeded the July estimate. About two-thirds (63%) of the total shrinkage of spring wheat occurred in the states of Minnesota, North Dakota, and South Dakota. In the first two states stem rust was undoubtedly the most important contributing factor, while a combination of stem rust and scab were chiefly responsible in South Dakota. The percentages of shrinkage in spring wheat for the principal spring wheat states in the Mississippi Valley section are as follows:

Minnesota........	46	Wisconsin........	36
North Dakota....	17	Michigan........	25
South Dakota....	36	Iowa............	28
Nebraska........	43	Illinois........	28

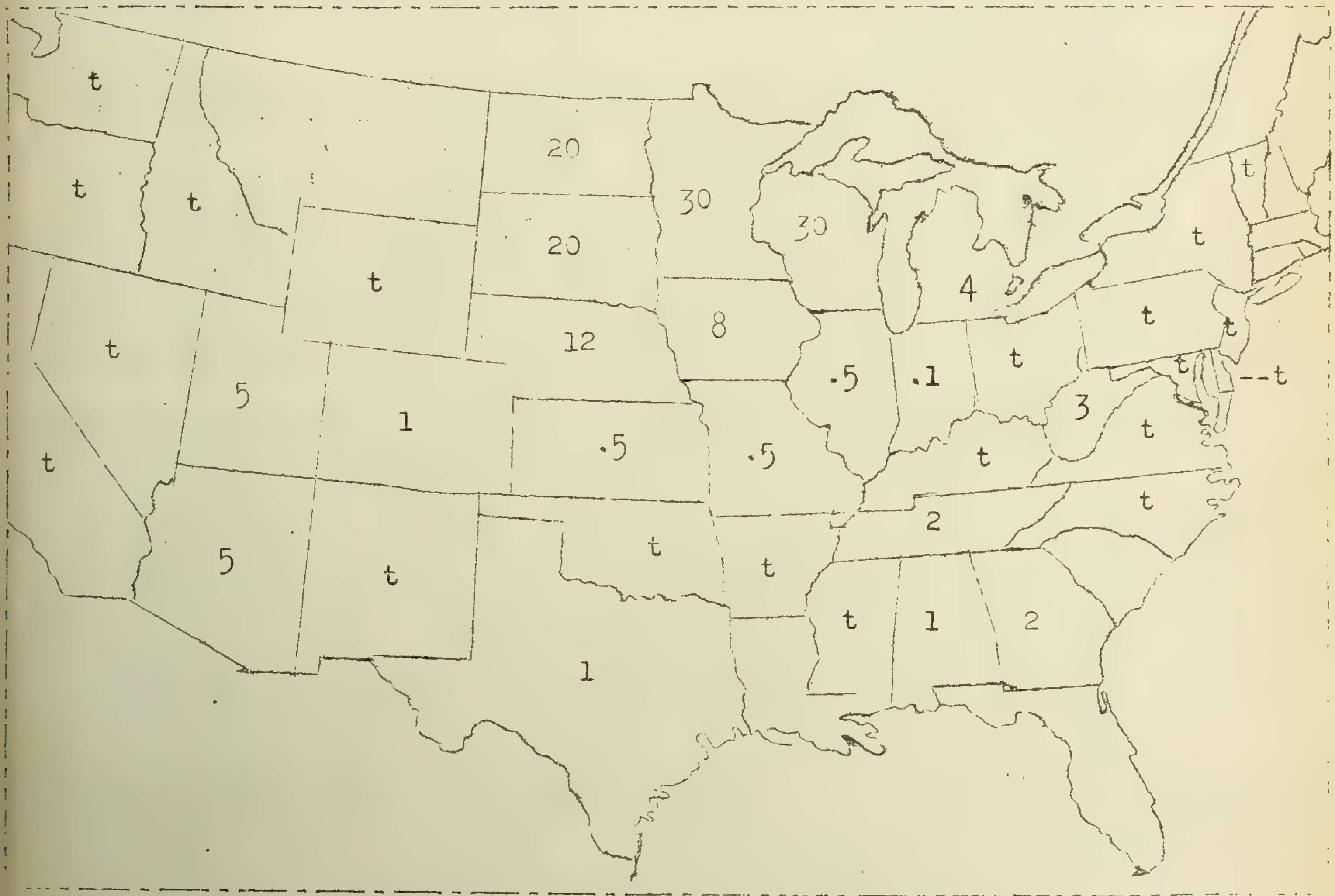


Fig. 24. Estimated percentage reduction in yield from stem rust of wheat, 1920.

Comments of especial interest on occurrence and severity of infection are as follows:

Michigan: "Stem rust probably reduced winter wheat by the average amount which, with leaf rust, has generally been believed to be under 5%. Frequent cases were found in the lower tier of counties where severe loss was associated with barberry plants in close proximity to fields. In the spring wheat area, which is largely in the Upper Peninsula, loss from black stem rust was worst in years, wheat in general being shriveled and of poor quality. At the Chatham station spring wheat was not harvested. A trip through that section showed any number of fields that looked pronouncedly sooty from a distance. I would place the loss at easily 25% in spring wheat.

The average weight of wheat in that county was 52 pounds to the bushel, against an average 60-62". (Coons)

Wisconsin: "Very heavy infection. The earliest planted fields are ripening ahead of great damage. The later plantings will hardly yield 25 to 50% of a crop. Fields on the east side of the state under influence of Lake Michigan show less rust than the interior and western sections. The small acreage of winter wheat had very little rust". (Vaughan)

Minnesota: "More prevalent and destructive than in 1919." (Section of Plant Pathology.)

North Dakota: "Stem rust has been very destructive in southeast North Dakota and in widely scattered areas, particularly in parts of Walsh and Grand Forks Counties". (Bolley)

"Rust, excepting in southeastern counties, was not severe in most parts of the state except in fields sown late. Marquis and Velvet Chaff were found practically free from rust in many fields I visited. In Stutsman County, which is almost entirely a durum wheat county and particularly a D-1 or Monad county, rust was not to be found except in an occasional late field of Marquis". (Weniger)

South Dakota: "Very general, from 10 to 100% of injury. Farmers taking to rust resistant durums. Favorable weather until a week later would have cut loss by 75%". (Arthur T. Evans)

Kansas: "Generally wheat stem rust was not serious in Kansas the past season. If it had appeared in the same amount a few weeks earlier no doubt serious injury would have resulted. The rainy spells stopped in sufficient time and very good weather for maturing the crop continued until harvest". (Melchers in Cereal Courier 12: 328. Sept. 30, 1920)

Dates of first appearance of uredinia, which are of particular interest, are as follows:

May 28	Alabama
June 8	Tennessee (uredinia abundant)
June 22	Minnesota
June 22	North Dakota.

Bisby found the first trace of rust (a single uredinium) on wheat at Winnipeg on June 30. He found infection on barberry June 5 and aecia open and shedding spores on June 11. Some sporulating aecia were found throughout June, July, August, and until September 16.

The occurrence of aecia of stem rust on species of Berberis and Mahonia in the United States as given by Arthur and Fromme (North American Flora 7: 295, 1920) is shown on the accompanying map. This is of especial interest in connection with the question of the sources of initial infection of wheat and other cereals and grasses for which two apparent possibilities exist: (1) overwintering of teliospores with subsequent infection of the aecial host followed by aeciospore infection of the telial host; (2) overwintering of urediniospores, or of dormant mycelium in the telial host, followed by reinfection of the telial host by urediniospores. Stakman, Kirby, and Thiel (The regional occurrence of *Puccinia graminis* on barberry. Phytopath. 11: 39-40, 1921.) have determined that teliospores in the south lose their viability during the winter and are hence incapable of germination in the spring. This offers an explanation for their observations that aecia on barberry are not commonly found south of 40° N. latitude, except at higher elevations where heavy infection was found as far south as 37°, and is in substantial agreement with the occurrence as shown on the map.

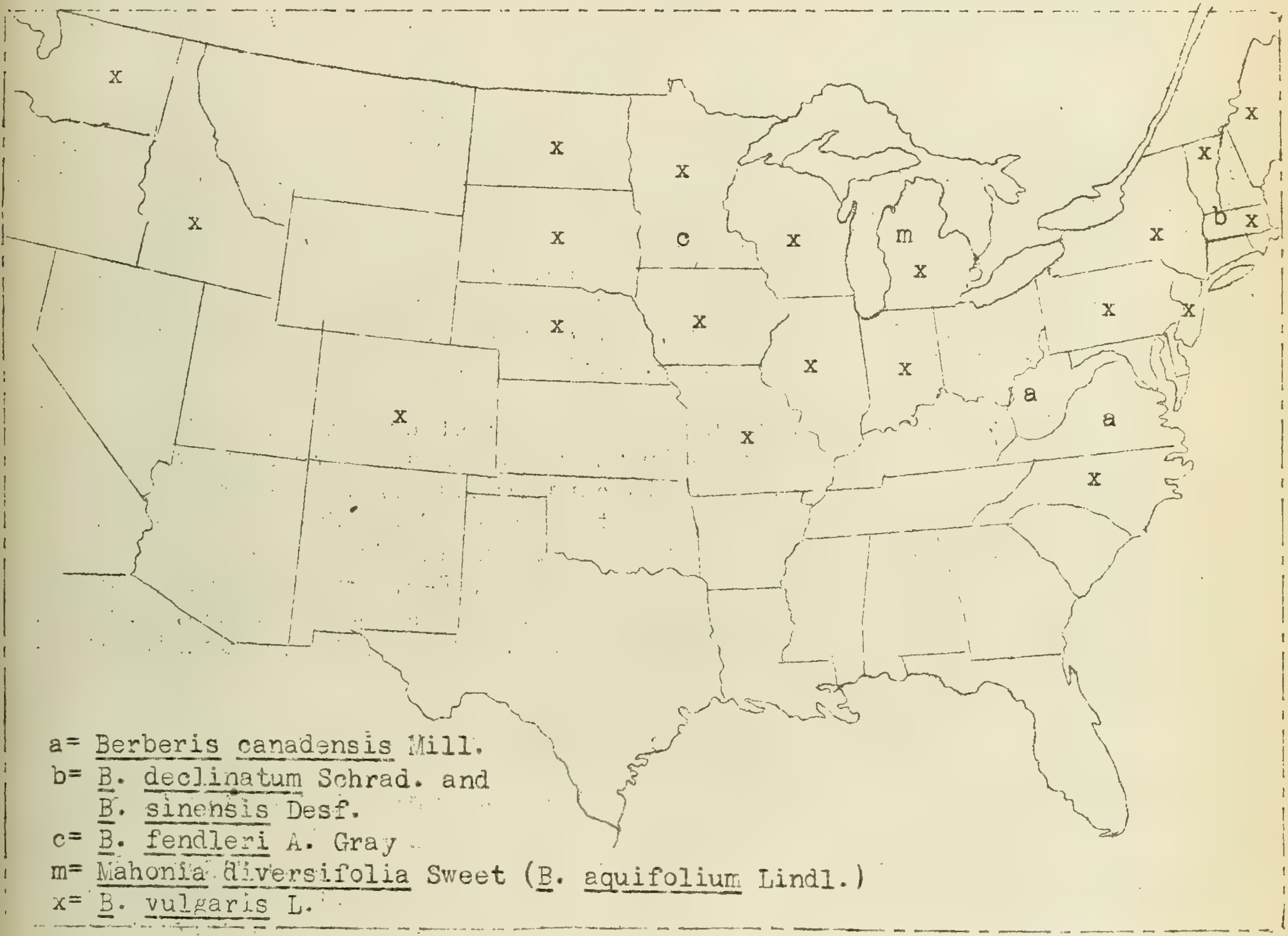

a= Berberis canadensis Mill.
b= B. declinatum Schrad. and
B. sinensis Desf.
c= B. fendleri A. Gray
m= Mahonia diversifolia Sweet (B. aquifolium Lindl.)
x= B. vulgaris L.

Fig. 25. Occurrence on various hosts of aecia of stem rust (*Puccinia graminis*) as recorded in the North American Flora. The different hosts are designated by symbols.

Stakman comments in part on the question of overwintering as follows (Cereal Courier 12: 241. July 31, 1920):

> "Stem rust did not overwinter in the uredinial stage on winter wheat at St. Paul, Minnesota. There is some evidence that it may have overwintered on a plot of winter wheat at Madison, Wisconsin. The presumptive evidence is strong that rust may have developed from barberry in eastern Nebraska, Iowa, southern Minnesota, and eastern South Dakota. On the other hand, it is quite possible that it may have spread gradually northward from farther south........ The only rust found on *Agrostis alba* so far has been traced to rusted barberry. Barberries began to rust early in May and rust began to develop in wheat fields about June 20. So far the circimstantial evidence is strong that much rust undoubtedly came from barberry. On the other hand there also is

evidence that some infection may have come from overwintered urediniospores and there also is some slight evidence that a certain amount of it may have spread from the South to the North".

Bolley makes the following comment with respect to North Dakota:

> "Observations in this state, and I think in others, are very convincing that much of the destruction is brought about by local attacks of rust arising from barberry bushes in the immediate neighborhood of the green fields."

The following notes and data on the susceptibility of varieties were obtained. Kanred was reported as showing resistance to stem rust in Illinois, Wisconsin, Nebraska, and Kansas. A. G. Johnson made observations on the experimental plots at Brookings, South Dakota, and noted that of the durum wheats, Kubanka showed considerable rust, while Acme, D-5 (North Dakota), Mindum, and Monad were slightly rusted, the latter two showing more than the others in the order given. All of the common wheats were heavily rusted, Kota less so than Marquis and Prelude. J. C. Brinsmade, Jr. comments on varieties at the Northern Great Plains Field Station, Mandan, North Dakota, as follows:

> "There is a high percentage of stem rust on most of the common wheats and some of the durums in the wheat nursery, which were sown late and in a low, damp spot. Kota is conspicuous for its practical freedom from stem rust while Marquis, Preston, Power Fife, Haynes Bluestem, Prelude, Ruby, and the hybrids between Kubanka and Preston and Kubanka and Haynes are severely rusted. Of the durums, D-5, Acme, and Monad are almost free from rust, while some of the Kubankas and Arnautkas, especially Kubanka C. I. 4063, and Arnautka C. I. 4064 are badly rusted." (Cereal Courier 12: 260. August 10, 1920.)

Progress of Barberry Eradication Campaign

by

F. E. Kempton, Pathologist in Charge, Office of Cereal Investigations.

> "The barberry eradication campaign has been pressed vigorously in the eradication area. It has proved to be a more extensive piece of work than was anticipated. Results obtained in the early part of the campaign seemed to indicate that the greater portion of common barberries were in towns and cities. The evidence obtained in the second year of the campaign disproved this conclusion. Accordingly plans were formulated with a view to inaugurating a systematic farm-to-farm survey. Through the execution of this plan it has become obvious that it is necessary to continue the farm-to-farm survey until all important grain-growing areas in which barberries are found to become infected with black stem rust are freed of this pest.
>
> "From the beginning of the campaign to December 31, 1919, the original survey of nearly all cities and towns, except Chicago, Cincinnati, Milwaukee, and villages of less than 300 population, either not accessible by railroads or in less densely populated parts of the States, was completed. In this survey, 1,299,461 bushes were located on 35,878 city properties. Nearby farms and those accessible from main highways traversed were surveyed also. The survey of all main ranches and all farms of the irrigated districts of Montana was completed. A preliminary farm-to-farm survey of a few counties or parts of counties in each

Table 46. Progress of barberry eradication campaign - Summary of state totals from the beginning of campaign to December 31, 1920, inclusive.

A. Number of properties with barberry bushes.

State	In Towns	In country Total	In country Wild	Town and country Found	Town and country Removed
Colorado	1,469	44	10	1,513	1,508
Illinois	6,440	316	193	6,756	6,278
Indiana	3,081	353	19	3,434	3,409
Iowa	6,466	816	172	7,282	5,797
Michigan	3,586	3,369	843	6,955	4,912
Minnesota	2,722	790	182	3,512	3,487
Montana	152	43	1	195	194
Nebraska	2,935	103	3	3,038	1,451
North Dakota	423	90	0	513	513
Ohio	3,686	326	41	4,012	2,622
South Dakota	372	144	31	516	464
Wisconsin	5,730	1,047	309	6,777	6,275
Wyoming	70	7	1	77	24
Totals	37,132	7,448	1,805	44,580	36,934

B. Number of bushes located and removed.

State	Towns	In country Total	In country Wild	Sprouting	Totals Found	Totals Removed
Colorado	19,882	1,760	1,397	1,195	21,642	21,245
Illinois	74,665	9,086	2,201	661	83,751	78,867
Indiana	75,025	10,134	2,441	1,852	85,159	83,918
Iowa	142,491	82,045	29,273	2,883	224,536	174,476
Michigan	35,951	103,696	58,743	187	139,647	92,276
Minnesota	588,104	145,431	50,868	7,241	733,535	733,065
Montana	6,577	2,105	1	4,515	8,682	8,671
Nebraska	71,000	6,057	801	1,325	77,057	61,240
North Dakota	3,782	1,110	0	215	4,892	4,892
Ohio	193,760	20,102	15,209	0	213,862	173,892
South Dakota	21,924	14,262	8,344	913	36,186	30,519
Wisconsin	75,472	3,030,711	3,024,352	8,284	3,106,183	2,013,955
Wyoming	3,932	168	1	190	4,100	492
Totals	1,312,565	3,426,667	3,193,631	29,461	4,739,232	3,478,508

state was made. The entire rural area covered was equivalent to 95 counties. A total of 1,933,841 barberry bushes were found on 5,776 farms showing that more barberries were to be found on farms than on city properties. Of this number, 1,758,244 bushes were escaped from cultivation on 1,425 farms, and the remaining 175,597 bushes were under cultivation on 4,351 farmsteads. The above figures total 3,233,302 bushes on 41,654 properties in this period. Of this total number 2,968,910 bushes have been removed from 31,455 properties. A resurvey of all properties found to have barberry bushes proved to be necessary as bushes were not always readily removed or were improperly dug by the property owners.

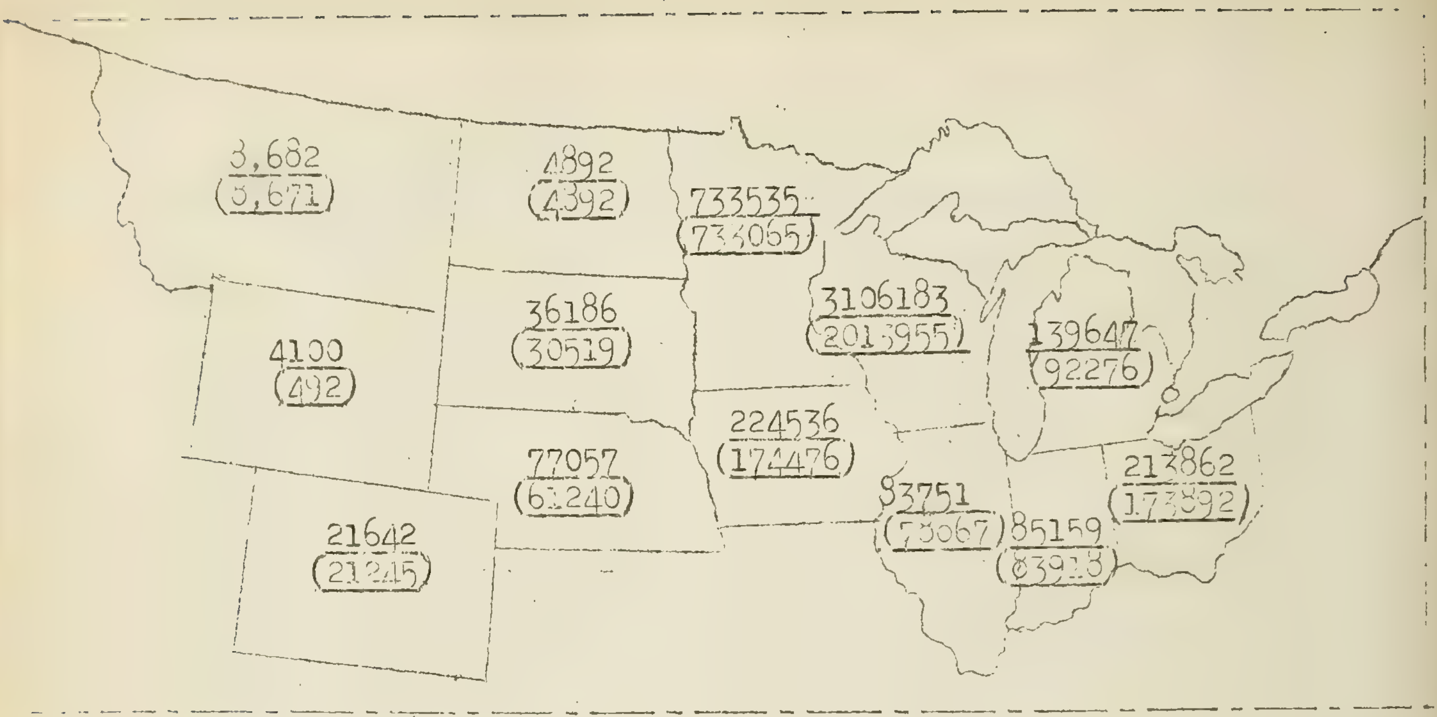


Fig. 26. Progress of barberry eradication. Barberry bushes found and (destroyed) April 1, 1918 to December 31, 1920.

Sprouts and seedlings often appeared. During this period 144,178 bushes and 5,886 sprouts were removed from 1,780 properties in resurvey work.

"In the period January 1 to December 31, 1920, efforts were concentrated upon the farm-to-farm survey. Every rural property and all properties not already surveyed in cities and villages included in the counties covered were surveyed in an area equivalent to 88 counties. The result of this farm-to-farm survey was that during the year 1,492,826 barberry bushes were found on 1,672 farm, 57,439 bushes being located on 1,292 farmsteads while 1,435,387 bushes were escaped from cultivation on 380 farms. These escapes had grown from seeds which had been scattered by birds and by farm animals that feed on the berries. They were found along fence rows, stream banks, in woodlands, orchards, windbreaks, old stone quarries, and on rocky cliffs. These areas of escaped bushes varied from one small seedling in the state of Wyoming to 1,335,000 bushes in one county in Wisconsin. In cities and villages, 13,104 bushes were found on 1,254 properties. In the original survey, 1,505,930 bushes have been located on 2,926 properties. 453,387 bushes were removed from 2,990 properties. In resurvey 72,684 bushes which had not been removed by the property owners were found remaining on 2,602 properties, but 56,303 bushes and 14,148 sprouts were removed from 2,478 properties. During the year a total of 1,505,930 bushes were found on 2,926 properties and 509,690 bushes were removed from 5,477 properties.

"During the entire campaign, April 1, 1918 to December 31, 1920, 1,312,565 bushes have been found on 37,132 city properties; 3,426,667 bushes on 7,443 farms; 233,036 bushes were on 5,643 farmsteads; 3,193,631 bushes were escaped from cultivation on 1,805 farms. In the farm-to-farm survey an area equivalent to 183 counties has been completed. This includes all the rural territory necessary to survey in Montana and in the western part of Colorado. A total of 4,739,232 bushes have been located on 44,580 properties; 3,478,508 bushes have been removed from 36,934 properties. of the 1,360,724 bushes remaining on 7,666 properties, 1,000,000 are bushes under 18 inches in height on one farm in southern Wisconsin. Many of the others remaining are in areas of escaped bushes or in large hedges too extensive to be eradicated immediately. While state lawa in all states except Wyoming require the property owners to remove them, time must be given to allow the task to be accomplished.

Table 47. Progress of barberry eradication campaign - Number of bushes escaped from cultivation on farms during entire campaign and during 1920 calendar year, also number of bushes found and destroyed from January 1, 1920 to December 31, 1920.

State	Number bushes escaped from cultivation		January 1, 1920 to December 31, 1920.	
	Entire campaign	Calendar year 1920	Number bushes found	Number bushes destroyed
Colorado	1,397	1,347	1,976	4,336
Illinois	2,201	1,205	2,042	2,663
Indiana	2,441	218	1,558	10,048
Iowa	29,273	2,219	13,710	10,860
Michigan	58,743	8,123	20,419	22,782
Minnesota	50,868	6,499	9,222	17,938
Montana	1	0	76	147
Nebraska	801	801	2,574	15,013
North Dakota	0	0	1,805	1,805
Ohio	15,209	12,543	18,798	66,733
South Dakota	8,344	5,473	8,789	10,631
Wisconsin	3,024,352	1,396,958	1,424,708	346,618
Wyoming	1	1	253	166
Totals	3,193,631	1,435,387	1,505,930	509,740

Lear rust caused by Puccinia triticina Eriks. and Henn.

The leaf rust of wheat was in general very much less severe throughout the country in 1920 than in 1919, in which year it was more prevalent and destructive than had ever been recorded previously. It was said to be present to some extent in every state from which reports were received and in general throughout the wheat-growing sections of the states in question. The states reporting the disease as less severe than in 1919 form a well-marked belt, constituting the middle tier of Eastern and Central states, with Pennsylvania and Iowa on the north, South Dakota, Nebraska, and Kansas on the west, and Arkansas and Tennessee on the south. North of this belt the disease was reported as about the same as in 1919 or more severe (same - New York and Wisconsin; more severe - North Dakota, Minnesota, and in the Upper Peninsula of Michigan). It was as usual prevalent and rather destructive in Georgia and other states south of this belt. The estimated percentage of reduction in yield for the different states is shown in the following tabulation:

Table 48. Estimates of percentage loss from leaf rust of wheat by states, 1920.

Percentage loss	States
4	Mississippi.
3	North Carolina.
2	Virginia, Georgia, Alabama, Arkansas, Oklahoma.
1.5	North Dakota, Maryland.
1	Kentucky, Missouri, Iowa, South Dakota, Nebraska, Texas.
.5	Illinois.
.1	Indiana.
t	Vermont, New York, Pennsylvania, New Jersey, Delaware, Ohio, West Virginia, Tennessee, Michigan, Wisconsin, Minnesota, Louisiana, Kansas, Colorado, New Mexico, Arizona, Utah, Idaho, Washington, California.

With respect to relative prevalence the following statement of Melchers is interesting:

> "Leaf rust was exceedingly rare in Kansas the past season (1920). There was no injury whatsoever caused. This is interesting in view of the fact that the year before one of the worst epidemics of leaf rust hit Kansas that has occurred for many years." (Cereal Courier 12: 328., Sept. 30.)

A careful comparison of climatic conditions in 1919 and 1920 would no doubt throw considerable light on the causes of the marked variation in severity of leaf rust. Such notes on the influence of climate as were received from collaborators indicate considerable difference of opinion as to effect of precipitation and temperature.

Two important new extensions in our knowledge of the leaf rust fungus have been reported from the Indiana Station, where H. S. Jackson, in collaboration with the Cereal Office, is in charge of the project on leaf rust investigation. These are: (1) the discovery of the existence of two strains of *P. triticina*; and (2) the successful culture of the rust from wheat on its previously unknown aecial hosts. In a preliminary note (Two strains of *Puccinia triticina* on wheat in the United States. Phytopath. 11: 40. January 1921.) Mains and Jackson report the separation of a number of uredinial cultures into two groups based on their ability or inability to infect certain selections of Malakoff and Turkey x Bearded Minnesota. They also comment on this as follows in the Cereal Courier for August 31, 1920:

> "As a result of greenhouse and field observations it has become evident that at least two fairly distinct strains of the orange leaf rust are to be found in this country. From the data now at hand it appears that these are to be distinguished fairly easily by the character of infection produced upon different wheat varieties."

They have also noted that certain varieties show differences in susceptibility according to the age of the plants, certain varieties which are highly resistant as they near maturity being moderately susceptible in the seedling stage.

With respect to the determination of the aecial hosts of P. triticina, Jackson and Mains (The aecidium of the orange leaf rust of wheat, Puccinia trititina. Phytopath. 11: 40. January 1921.) record infection resulting in the development of pycnia or aecia on 12 species of Thalictrum from sowings of wintered teliospores. The most vigorous development of aecia was obtained on four exotic species, and only occasional infection with weak development of aecia was obtained on the native species used. Aeciospores from Thalictrum were sown back on wheat with the production of typical uredinia of Puccinia triticina.

No very definite dates of first appearance were reported. Bolley states that leaf rust was noted on wheat in North Dakota when the plants were a few inches high. It is evident, for the South at least, that the rust winters over on fall sown grain. Fromme notes that the rust was present throughout the winter on wheat at Blacksburg, Virginia, while Temple makes the same comment with reference to Maryland. Johnson supplies the following note concerning hibernating mycelium:

> "On March 28, Mr. McKinney dug up some wheat plants at Granite City, Illinois, and shipped them to us here at Madison. We placed them in the greenhouse and on April 12 it was with especial interest that I noted the development of a number of new uredinia of leaf rust on one of the old, green leaves. They were apparently developing around an old lesion, hence there was rather definite evidence of hibernating mycelium."

E. B. Mains has kindly supplied the following note regarding varietal susceptibility in tests at Lafayette, Indiana:

> "There was not enough P. triticina on winter wheat at Lafayette in the spring of 1920 to give field data on varietal susceptibility. Spring wheat, however, was fairly heavily rusted. The club wheats were all very heavily rusted the latter part of July showing 65-100%. The emmers were in general very resistant, the most susceptible variety, Red Emmer from Canada, showing 25% accompanied, however, with hypersensitiveness. The durums were all very resistant, 0-10%, except Arnautka C. I. 1493, which showed 25-30% with hypersensitiveness. The einkorns were immune. Polish C. I. 5524 showed only a trace, while C. I. 3007 showed 15-25%. White Spring Spelt was only slightly rusted while Bearded Spring C. I. 4776 showed 5-20%. Of the bread wheats none were immune, Marquis showing the lowest percentage of rust, 30-40%, just before harvest."

Bolley notes leaf rust to have been confined rather especially to certain varieties in North Dakota, being much more severe on some than on others, with the durum wheats especially free. Valleau reports the variety Ashland very free from leaf rust at the Experiment Station at Lexington, Kentucky.

Stripe rust caused by Puccinia glumarum (Schm.) Eriks, & Henn.

The only definite reports of stripe rust received in 1920 were from Oregon and California. In the latter state it was reported by Mackie as occurring in the cereal plots at Eureka, affecting Early Baart more than other varieties. The accompanying map shows the occurrence of stripe rust on wheat, rye, barley, and its various grass hosts by states as recorded in the North American Flora 7^5: 338. 1920.

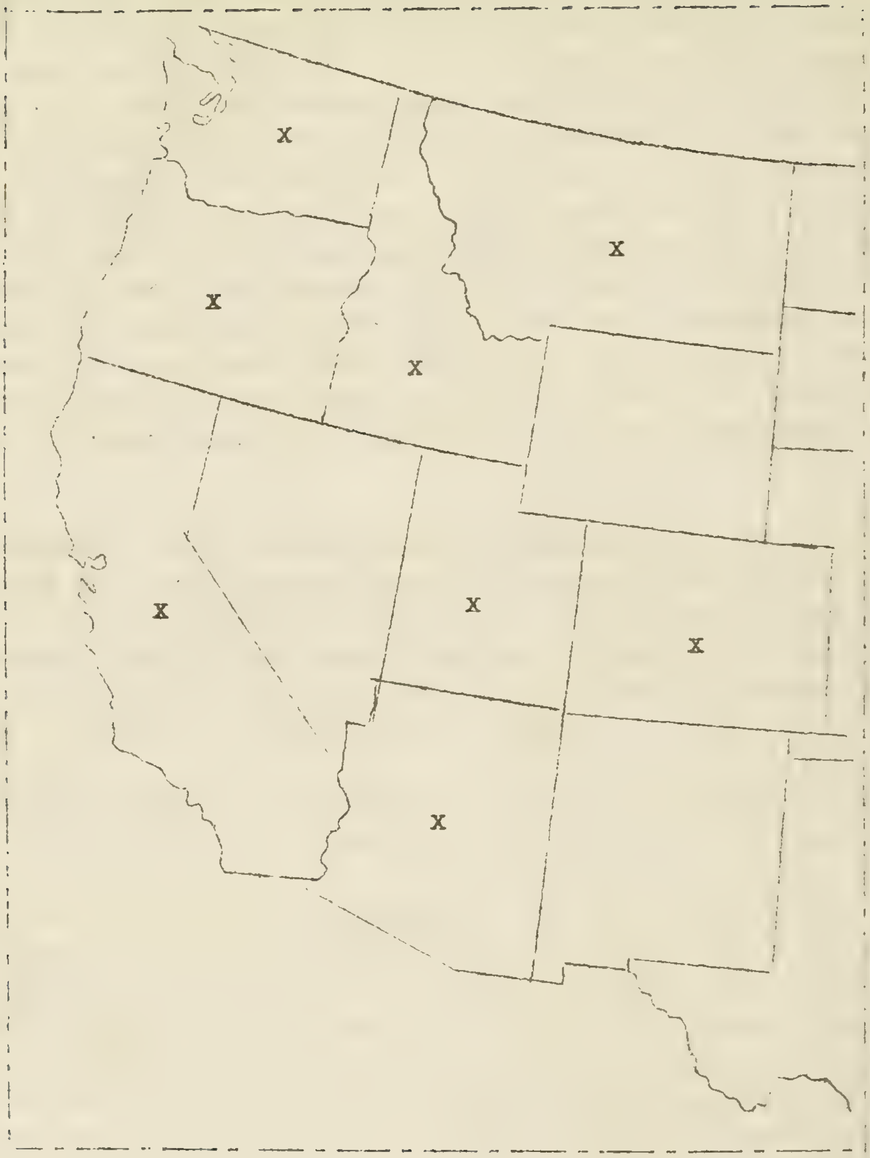


Fig. 27. Occurrence of stripe rust, Puccinia glumarum, on cereals and grasses in the United States, as recorded in North American Flora 7⁵: 338. 1920. Also recorded from the provinces of British Columbia and Alberta, and from Mexico.

Scab (blight) caused by Gibberella saubinetii (Mont.) Sacc.

Wheat scab, although it occurred over practically the same range as in 1919, was very markedly less severe in intensity throughout its range with a few local exceptions. In most of the states infection occurred on the heads rather generally but the percentage of affected heads was slight. Seedling blights, ascribed to this fungus or to Fusarium spp., were reported from Virginia, Delaware, Wisconsin, North Dakota, and Idaho. They were of minor importance as a rule. The occurrence of the head blight, as well as the estimated percentage reduction in yield for the different states is shown in the accompanying table and map. Losses for 1919 are also shown for comparison with those of 1920. It will be noted in the states in which the disease was epiphytotic in 1919 that the decrease in severity in 1920 was very striking. This is true of all states with the exception of South Dakota where Evans estimates the loss in 1920 as 15% as compared with 10% in 1919, and for localities in Kansas and Nebraska.

Table 49. Comparison of losses from wheat scab (blight) in 1919 and 1920.

Division	State	Estimated percentage loss	
		1919	1920
North Atlantic	New York	t	t
	Pennsylvania	3	1
	New Jersey	4	1
South Atlantic	Delaware	4	.5
	Maryland	5	1
	West Virginia	15	1
	Virginia	2	t
	North Carolina	5	t
North Central (East)	Michigan	-	t
	Ohio	8	.5
	Indiana	12	.5
	Illinois	18	2
	Wisconsin	9	1.5
North Central (West)	Minnesota	7	2
	North Dakota	5	1
	South Dakota	10	15
	Nebraska	1	1
	Kansas	t	t
	Iowa	20	.5
	Missouri	6	2
South Central	Kentucky	8	2
	Tennessee	8	t
	Alabama	t	t
	Arkansas	t	t
	Texas	t	1

Extracts from reports dealing with the few localities where head blight was severe follow:

Kansas: "Reported in Labette County. Practically every field showed enough injury to reduce the yield from one to six bushels. Soft wheats are grown in this county." (Melchers, July 15)

"This year for the first time distinct injury occurred in Labette County as well as some injury in adjoining counties (Cherokee). In Labette County in particular, very many fields were reduced at least 25% in yield due to wheat scab. Climatic conditions were very favorable for this disease the past year. It is of interest to note that in August specimens of corn root rot had been sent from this same county. According to county agent reports the injury from scab in many fields is serious." (Melchers in Cereal Courier 12: 328. Sept. 30, 1920.)

Nebraska: "Severe infection around Dakota County, 25-50% of the wheat in this section is infected with scab." (R. W. Goss)

"Severe damage from black rust and scab reported." (Weekly Crop Notes of the Bureau of Crop Extimates, Aug. 12)

"Crop very light due to rust and scab." (Weekly Crop Notes, Aug. 19)

"Crop was seriously damaged by black stem rust and scab and much will not be threshed. Yields cut 50% or more." (Weekly Crop Notes, Sept. 16)

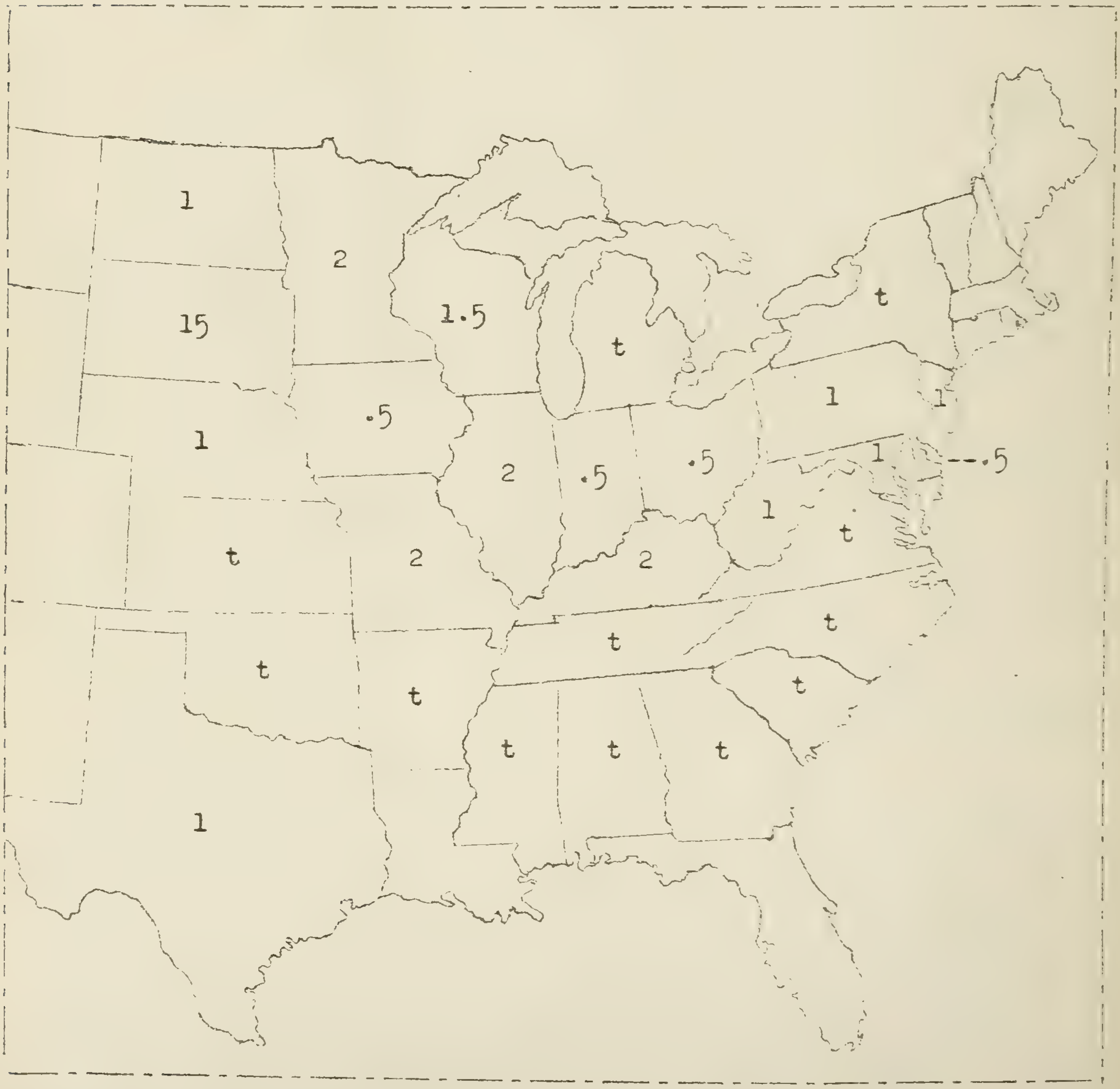


Fig. 28. Percentage losses from wheat scab, 1920.

South Dakota: "Scab is very bad in wheat (Marquis) in every part of the state. Rust developed fast under most favorable conditions (foggy weather) during the middle and latter part of July. These two diseases alone have ruined a most promising crop, the best prospect South Dakota has had in years. Many fields will not make more than one or two bushels per acre and that of inferior grade." (Arthur T. Evans.)

No doubt climatic conditions were chiefly responsible for the slight head blight in 1920. Dickson, Johann, and Wineland (Second progress report on the Fusarium blight (scab) of wheat. Phytopath. 11: 35. 1921) have found great differences in perithecial development for the seasons of 1919 and 1920 - 51% of the specimens in 1919 and 15% in 1920 - and suggest that this is closely associated with moisture. They also find that the highest percentage of infection occurs during the period of flowering. Comments from the states on climatic conditions are as follows:

West Virginia: "I believe the decrease in scab is largely due to different weather conditions when the grain was in bloom." (Giddings)

Virginia: "There were practically no rains during the heading period in 1920 while rains were very frequent during the same period in 1918 and 1919." (Fromme)

North Dakota: "Dry weather preceding harvest prevented general distribution from field to field." (Bolley)

Ohio: "While we have had prolonged rainy periods with much cloudy weather during the harvest season in Ohio, the scab infection upon wheat appears much less prevalent than in 1919. It is felt that the greater care in the preparation of seed wheat and attention to screening and seed treatment have been important in this respect." (Selby)

Wisconsin: "Wet early, followed by dry weather commencing in late June." (Vaughan)

The dates of first appearance of the head blight as given by collaborators are as follows:

June	Arkansas	July 5	South Dakota
Last of June	Indiana	July 7	Ohio
Last of June	Illinois	July 9	Minnesota
July	Wisconsin	July 19	Pennsylvania

Comments and data on the relation of head blight to preceding crops of corn are in agreement with notes which have appeared in previous Supplements of the Plant Disease Bulletin. The following is of especial interest:

> "Fusarium blight or scab was found in 46 fields ranging from only a trace in most of the northern portion of Wisconsin and northeastern Minnesota where the only fields showing a moderate scab infection were on corn land, to 40% in one of the southern Wisconsin fields. The highest percentages of scab were in southern Wisconsin, one field on corn land showing 40% by count. In general scab was only present in large quantities where wheat followed corn." (J. G. Dickson)

The following data obtained in the section between Minneapolis and Elk River, Minnesota were submitted by A. G. Johnson:

Wheat after corn	36% affected heads
Wheat after corn	33% affected heads
Wheat after corn	34% affected heads
Wheat after corn	30% (est.) affected heads
Wheat not after corn	trace affected heads
Wheat not after corn	trace affected heads

Various seedling blights, foot-rots and root-rots of wheat.

In the present imperfect state of our knowledge of the seedling-blights, foot-rots and root-rots of wheat that occur in different parts of the United States it seems best to treat them, as in the following, under three groups. It is not assumed that this will be the correct grouping when more definite knowledge of the causative agents is obtained. The seedling blight caused by Gibberella saubinetii and Fusarium spp., which is quite readily distinguished from the other seedling blights, is treated separately under wheat scab (blight).

Foot rot or "so-called take-all" possibly caused by Helminthosporium sp. Apparently there is still some question as to the cause of this disease which is known definitely only from certain localities in Illinois and Indiana. Although both Stevens and McKinney (F. L. Stevens, Foot-rot of wheat. Science n. s. 51: 517. May 21, 1920. H. H. McKinney, The so-called take-all disease of wheat in Illinois and Indiana. Phytopath. 11: 37. 1921) have obtained a Helminthosporium from diseased plants, neither has as yet produced the typical stunting and proliferation, which is so characteristic of this disease, from inoculations with this fungus. Both have obtained local lesions, but McKinney states that he finds these lesions common to all varieties of wheat and on plants which do not show stunting and excessive tillering. There is a suggestion, however, according to McKinney, that the so-called take-all is an unusual manifestation of the Helminthosporium disease of wheat which is present in many sections. The disease was severe in Madison County, Illinois, in 1920 but was less extensive than in 1919. It also recurred in an experimental field in Porter County, Indiana. Field tests of wheat varieties at Granite City, Illinois, which were cooperative between the Cereal Office and the University of Illinois, have shown very marked differences in varietal susceptibility, and resistant varieties, therefore, seem to offer the most promising and feasible means of control. These tests show that Red Wave, May and a strain of Turkey wheat are not susceptible to the disease, while the white-chaffed, red kernel type of Red Cross (Salzer's Prizetaker) and Illini Chief are very susceptible. A number of other varieties are only slightly susceptible.

Helminthosporium blight caused by species of Helminthosporium. A seedling blight of wheat which is ascribed to species of Helminthosporium was reported by collaborators from Wisconsin, North Dakota, Minnesota, Kansas, and Kentucky. This trouble, which has been reported from North Dakota and Minnesota in Plant Disease Bulletin Supplement 8: 36. May 1, 1920 has recently been described as it occurs in Minnesota by Louise C. Stakman (A Helminthosporium disease of wheat and rye. Minn. Agr. Exp. Sta. Bul. 191. July 1920). The disease as it occurs in Minnesota is primarily a foot and root rot of seedlings but also occurs in all parts of the plant. A similar trouble is found in rye and in various grasses. While the exact status of the species of Helminthosporium associated with this type of disease is as yet undetermined and the identity of the trouble in the various states is uncertain it seems best for the present to treat them under the same group, but separately from the foot-rot or so-called take-all which occurs in Illinois and Indiana. The following comments are quoted from reports of collaborators and others:

> Wisconsin and Minnesota: "The occurrence of a seedling blight of wheat probably due chiefly to Helminthosporium sp. in the northern portion of the two states is worthy of special comment. Fourteen fields of wheat showed a blight quite different from the so-called take-all, ranging from a trace in most cases to 17% in one field. The latter field showed considerable spotting which could not be accredited to soil conditions. All isolations made from the field gave the typical

Helminthosporium which seems to be causing the blight through these regions. The seedling blight was generally present on the peat soils in Minnesota north of Duluth, varying with different varieties and methods of tillage. Mr. Barker of Minnesota reported similar observations in connection with his survey work in that state. This seedling blight seems in general quite different from that caused by Gibberella and Fusarium species and can generally be distinguished by the difference in color and presence of lesions on the leaves of the Helminthosporium blight. While the Helminthosporium seedling blight was found through the northern regions surveyed there are no indications that this is connected with the so-called take-all." (James G. Dickson)

Minnesota: "Minnesota Bulletin 191 summarizes our information about these diseases. This year the disease either did not reappear or was much less serious on many of the farms on which it almost destroyed the crop last year. While the foot rot as occurring in Minnesota undoubtedly is due to Helminthosporium and various other fungi, the condition of the grain plant has a great deal to do with the seriousness of the diseases." (E. C. Stakman)

North Dakota: "Spring wheat diseases showing their usual characteristic stages. In the old constantly cropped fields good examples of Helminthosporium and also fusarial root rot. In some cases the Helminthosporium acts quite characteristically like take-all of winter wheat. No doubt it would take on these characteristica much more definitely if it were not for the fact that under our spring conditions spring varieties run up with very much greater rapidity, and the atmosphere here is less moist than in the winter wheat regions." (H. L. Bolley)

"Helminthosporium on wheat was found on durum varieties especially D 5, D 1, and Kubanka, as a blade blight and also as lesions on the bases of the culms and on the glumes and grains. From one to five per cent of the heads were attacked in fields examined. As a blade blight, infection was found to run as high as eighty per cent." (Wanda Weniger)

Kansas: "Some young plants had root infection." (Melchers)

Kentucky: "Wheat came through the winter in the usual condition but when the roots were dug and washed in spring as growing just commenced, they were found to have no live roots but were producing a new root system from the crown. A study made on seed borne organisms shows that a very high percentage of what appears to be perfectly normal seed wheat is infected with an organism, probably Helminthosporium, capable of causing a root rot and seedling blight. This may account for the death of the roots during the winter." (Valleau)

Take-all probably caused by Ophiobolus graminis Sacc. The name "take-all" which has been used previously with reference to the foot-rots occurring in Illinois and Indiana should probably be restricted to those types of foot-rots with which species of Ophiobolus are associated. Apparently the first published report of the occurrence of Ophiobolus in connection with a foot-rot of wheat in this country is that of H. H. Whetzel in Plant Disease Bulletin 4: 103, October 15, 1920, and of R. S. Kirby and H. E. Thomas in Science n. s. 52: 368, October

15, 1920, both of which deal with the occurrence of a root and stalk disease in a field of wheat at East Rochester, New York, in 1920, with which a species of Ophiobolus has been found associated. Kirby and Thomas state that both the fungus and the disease symptoms with which it was found associated agree in essential details with the take-all of wheat and Ophiobolus graminis as described in Australia, France, and elsewhere.

F. D. Heald has kindly furnished a summary (prepared by F. D. Heald, E. F. Dana, and G. L. Zundel) of the information on the foot-rot of wheat which occurs in Washington based on studies made in 1918 and 1919. They state that perithecia of an Ophiobolus, which agrees most nearly with O. graminis Sacc., were found on specimens from one field at Shelton, Mason County, Washington. Various other ascomycetes were encountered in the material examined and the pathogenicity of none of these has as yet been determined. In all, foot-rots of wheat have been found in ten counties in the state as follows: Clarke, Cowlitz, Klickitat, Lewis, Mason, Pierce, Snohomish, Spokane, Thurston, and Whatcom, while similar troubles have been reported from Clarke County on oats and from Pierce County on barley. With respect to severity the following statement is quoted from the report:

> "Estimates of losses were made in fields visited by the writers in 1919. In Thurston, Vancouver, and Mason Counties of western Washington losses of 95%, 50%, and 25% respectively, were found. More extensive acreages were involved in eastern Washington. Losses ranged from 30-90% of the crop in certain fields in Klickitat County and one locality of Spokane County. In other places in Spokane County small loss was incurred."

And with respect to climatic conditions:

> "Climatic conditions are probably an important factor in the development of foot-rot. Spring temperatures have been subnormal during the two years that the disease has been under observation."

Other foot-rots and root-rots, causes unknown. Other root and foot troubles, the causes of which have not been determined, were reported from Kansas, Missouri, Oklahoma, and Maryland. There was no recurrence of the trouble reported from Roanoke, Virginia, last year. The foot rot in Kansas was found at Abilene and is considered by Melchers as possibly similar to the Illinois trouble. Learn reports a foot-rot and white heads as occurring in different localities in Oklahoma especially at Enid. Some plants were dwarfed and died when a few inches high, and 25% of white heads was found in one field. Black pycnidia, containing hyaline, oblong spores, were found at the lower nodes. Temple reports a root-rot of wheat in Maryland different from the one in Illinois, in which the diseased plants head but produce little or no grain.

Nematode disease caused by Tylenchus tritici (Stein.) Bast.

The nematode disease of wheat and rye did not occur, so far as is known, in 1920 in any states other than those from which it was recorded in 1919; namely, West Virginia, Virginia, and Georgia.

R. W. Leukel, who made a special survey in the states of North Carolina, Tennessee, and Ohio in August and September, 1920, reports finding no infection in these states. The search was made in counties which border closely on areas of known infestation - Sullivan County in Tennessee, the northern tier of counties in North Carolina, and Lawrence and Gallia Counties in Ohio. The galls which were found at a mill at Gallipolis, Ohio, in 1919 were found by Leukel to have come from a farm near Beech Hill, Mason County, West Virginia. This is the first definite record of occurrence in the Ohio River Valley, all previous records from West Virginia having been in counties on or near the Virginia border. Later in the autumn Mr. E. C. Sherwood, West Virginia Extension Pathologist, visited the farm at Beech Hill and found nematode galls in the wheat. The farmer did not plant any wheat in the fall of 1920 and agreed not to raise any for two or three years, and also to dispose of his wheat in such a way as to prevent the further spread of the nematode. From other evidence furnished by millers at Gallipolis, Ohio, it is not unlikely that wheat nematode may exist on more than the one farm in that general locality.

Giddings states that the disease was about the same in relative prevalence in West Virginia as in 1919 with losses slight for the state as a whole. In Virginia the disease is said by Fromme to be less prevalent than in 1919 and less destructive in individual fields as a rule. This is thought to be due, partly to winter killing of infected plants, and also in some measure at least, to the educational campaign for clean seed and crop rotation. In Georgia, where the disease is known only in Jackson County, it is reported by McClintock to be spreading and to be more serious than in 1919. The loss in Virginia was estimated at .1% for the state. A. G. Johnson and R. W. Leukel report, as the result of their experiments at Arlington, Virginia, (The nematode disease of cereals. Phytopath. 11: 41. 1921) severe infection of wheat, rye, emmer, and spelt. Oats and barley were practically immune although in a few cases rudimentary galls were obtained. Dissemination by the movement of larvae took place horizontally only about four inches, but the larvae moved upward from a depth of twelve inches. They find that the larvae die in less than a year in moist soil, and, in a field test, that one year of grass between wheat crops resulted in a disease-free crop of wheat on land that had been badly infested. Kanred was the only variety of wheat tested which showed consistent resistance.

Black chaff caused by Bacterium translucens undulosum Smith, Jones, & Reddy.

In 1920 black chaff was a disease of minor importance, in the states in which it occurs, the only report of serious injury coming from Oklahoma. No new states were added to the list of those given in previous Supplements of the Plant Disease Bulletin. The disease was reported from Arkansas (some fields generally infested, others almost or quite free; no damage), Wisconsin (found only in Plant Pathology cereal plots where Kansas seed was used), Iowa (present on leaves, only a trace on heads; much less than 1919), North Dakota (found only in the vicinity of Fargo; a disease of minor importance and apparently confined to the bread wheats), South Dakota (very general, some in every field, but no apparent damage), Kansas (present in very slight amounts in only a few fields, no damage whatever), Idaho (common at Idaho Falls, but not found elsewhere), and Oklahoma (not as prevalent as last year, but in new localities; reported by farmers as killing the plants in one locality).

Anthracnose caused by Colletotrichum cereale Manns.

No report of serious injury to wheat from anthracnose was received. Apparently it was much less severe than in 1919 in the few states in which it has been of importance. Reports of definite occurrence in slight amounts with little damage were received from New York, New Jersey, Virginia, Kentucky, Tennessee, Ohio, Alabama, Mississippi, Arkansas, Texas, Wisconsin, and Iowa, while it was said to be general in Delaware and responsible for a loss of 1% for the state.

Glume blotch and leaf spot caused by *Septoria* spp.

It has been difficult to distinguish between these diseases, which are apparently caused by two distinct species of Septoria, owing to the fact that they have been commonly reported under the same head. Future reports should distinguish between the glume blotch and leaf spot as far as possible.

Glume blotch and leaf spot occurred in practically all of the states east of the line marked by Minnesota on the north and Arkansas on the south, but were in general very much less prevalent and unimportant in these states than in 1919 when they attracted unusual attention. West of this line they were reported as occurring to a slight extent in North Dakota, Texas, Idaho, and California. They were said to be quite serious locally in Pennsylvania with as much as 50-90% infection on experimental wheat plots at State College. In no state were the losses estimated to exceed a trace except in Delaware where Manns states that infection was general with an estimated reduction in yield of .25% and in Maryland where Temple reports it as present in all fields, causing leaf blight, and estimates the loss at .5%. Infection was noted to be much less prevalent than in 1919 in Virginia, Indiana, Iowa, and Arkansas, while in Minnesota it was somewhat more prevalent than in 1919. Leaf spot was noted in Idaho as occurring only on seedlings, none seen on heads. Several collaborators note infection to be more severe on plants injured by other causes. It was associated with Hessian fly injury in Ohio; it followed rust and was worst on badly rusted plants in Minnesota, and was correlated with poor soil fertility in Pennsylvania. The earliest record of occurrence was in Wisconsin where it was found by Johnson on April 16 on wintered-over green leaves of fall sown wheat.

Ergot caused by *Claviceps purpurea* (Fr.) Tul.

Ergot was reported as occurring in wheat in 1920 from the states of North Dakota, Minnesota, Wisconsin, Nebraska, Illinois, Kentucky, Arizona, and Utah. One case was reported from Blair County, Pennsylvania, but was unconfirmed. It was of slight importance in most states except in Minnesota where the decrease in yield for the state was estimated as -1%. Extracts from reports are as follows:

> Minnesota: "Worse than ever before. One variety of *Triticum durum* on the University Farm heavily affected." (Division of Plant Pathology)

> North Dakota: "The one disease which seems to be making progress from one year to another, particularly in the durum wheats, is ergot. It may be that we shall have to make a rather definite fight against this fungous infection. I am inclined to think, however, that it will gradually lessen with more intensive agriculture rather than increase. This will probably come about from a more careful mowing and pasturing of native grasses on the drier lands." (Bolley)

In addition to wheat, ergot was said to occur on the following grasses in Wisconsin: *Agropyron caninum*, *A. repens*, *A. smithii*, *A. tenerum*, *Agrostis palustris* (*A. alba*), *Arrhenatherum elatius*, *Bromus inermis*, *Calamagrostis canadensis*, *Dactylis glomerata*, *Elymus canadensis*, *E. virginicus*, *Festuca elatior*, *Glyceria fluitans*, *Hordeum jubatum*, *H. vulgare*, *Phleum pratense*, *Poa compressa*,

P. pratensis, Secale cereale. Hungerford states that ergot is common on Lolium sp. and Bromus spp., especially B. condensatus, in Idaho.

It is unknown as yet whether or not distinct strains of the fungus occur on different grass hosts. McFarland has recently reported, as the result of cross inoculation work, (Phytopath. 11: 41. 1921) the infection of wheat in a few cases with conidia from rye, Arrhenatherum elatius, poa pratensis, and Agropyron repens. He found it more difficult to secure infection of wheat than of rye. Rye was infected with conidia from these three grasses and from Bromus inermis.

Powdery mildew caused by Erysiphe graminis D.C,

Although occurring rather generally throughout the country,powdery mildew of wheat was of slight importance and the estimated average loss did not exceed a trace in any state. It was especially prevalent and caused some injury locally, but was of minor importance for the crop as a whole in New York, West Virginia, Ohio, and Utah. As much as 80% infection was recorded in New York.

Other diseases.

Node disease, associated with Alternaria sp. was reported by Melchers from Kansas as follows:

> "Several instances have been reported and specimens examined of a culm infection which seems to be due to an Alternaria species. The culms become brittle at the nodes and break. Considerable loss due to the breaking over of heads has resulted in some fields." (Cereal Courier 12: 329. September 30, 1920)

Sooty mold caused by Hormodendrum cladosporioides Sacc. was reported by Mackie from six counties in California, severe in Humboldt and Contra Costa Counties. At Salinas this fungus was said to have ruined what would otherwise have been excellent yields. The only report from any other state to the Plant Disease Survey is that of Oregon in 1918.

RYE

Stem rust caused by Puccinia graminis Pers.

Stem rust of rye occurred to some extent in most of the states where rye is grown but usually in negligible amounts. It was of slight importance in three of the four leading rye states; Michigan (only a little present), North Dakota (not observed), Minnesota (not important) but caused an estimated reduction in yield of 5% in Wisconsin. The most severe losses occurred in South Dakota, where infection was general with an estimated reduction in yield for the state of 10%. Of the southern states, the only one reporting injury was Georgia with 2% estimated loss. In the other states reporting definite occurrences - New York, New Jersey, Maryland, Virginia, Indiana, Illinois, Iowa, Nebraska, Missouri, Oklahoma, Arkansas, Texas, Utah, Idaho, and California -

losses did not exceed a trace. In New York, Kirby reports having found it first on Agropyron repens near a barberry, June 9, and later on rye. It was more severe on late than on early rye in South Dakota.

Leaf rust caused by Puccinia dispersa Eriks.

Leaf rust occurred in practically all states east of Montana and Texas, but was generally much less prevalent and severe than in 1919. Although it was generally more prevalent than stem rust, the losses occasioned by leaf rust were reported as none or a trace except in Tennessee (2%), Georgia (2%), Maryland (1%), Iowa (.5%), and North Dakota (.5%). In Tennessee the disease occurred throughout the winter, according to Essary, Kurtzweil, and Hesler, and was general over the state, causing practically 100% injury. The rye crop in that state, however, is not usually cut for seed.

The first report for the northern states was from Wisconsin on May 3.

Scab (blight) caused by Gibberella saubinetii (Mont.) Sacc.

Scab on rye was reported as occurring in 1920 in New Jersey, Delaware, Virginia, Ohio, Kentucky, Tennessee, Arkansas, Illinois, Wisconsin, Minnesota, and North Dakota. Losses exceeding a trace were reported only from Wisconsin (.1%) and from North Dakota (.5%). This was in marked contrast with the season of 1919 when the disease was epidemic in most of the corn belt states with losses ranging from 2-3% in Indiana, Illinois, Wisconsin, Minnesota, South Dakota, Iowa, and Missouri. The only report of severe infection in individual fields received in 1920 was from Tennessee where 50% head infection was observed.

Anthracnose caused by Colletotrichum cereale Manns.

Anthracnose of rye was of very slight importance in the country in 1920. It was reported as occurring to a slight extent in New York, New Jersey, Delaware, Virginia, Kentucky, Texas, Arkansas, Ohio, Wisconsin, Minnesota, and North Dakota. In Illinois it was said to be general and caused a loss of possibly 1%. In Pennsylvania (Lycoming County) it was reported from one locality where it caused heavy loss

Powdery mildew caused by Erysiphe graminis DC.

Powdery mildew of rye was reported from Massachusetts, New York, New Jersey, Virginia, Texas, Ohio, and Wisconsin. It was of little or no importance in most cases.

Stem smut caused by Urocystis occulata (Wallr.) Rab.

Reports of the occurrence of the stem smut of rye in 1920 were received from Massachusetts, New York, Pennsylvania, New Jersey, Maryland, Virginia, Georgia, Texas, Indiana, Illinois, Wisconsin, Minnesota, and Iowa. The reduction in yield is estimated at 1% for Minnesota and Georgia, .1% for Indiana and Massachusetts and a trace for the other states reporting. Kirby reports that 10% infection occurred in one field in Dutchess County, New York, and that the disease was very prevalent in Columbia County on Rosen rye. Stem smut has been reported in previous years from practically every state east of the Rocky Mountain States and also from Arizona. There are no records in our files of its occurrence in the Pacific Coast States.

Head smut of rye caused by Ustilago sp.

This smut, which appears to be very rare in the United States, was reported in 1920 from Virginia and Indiana. A few heads were found at Arlington Farm, Virginia by members of the Cereal Office, Reed, Leighty, Tapke, and J. W. Taylor, and one head was found at the experimental farm at Staunton, Virginia by Reed and Fromme. H. S. Jackson and A. G. Johnson found six affected heads in a plot of Rosen rye in an experimental field at Wanatah, Indiana. The head smut of rye has been noted in previous years from Tennessee, Indiana, Virginia, Minnesota, Missouri (reported two or three times), and North Dakota (first record by Humphrey, who found one head in spring rye at Dickinson in 1913). It has not been referred definitely to any species of Ustilago and possibly is either an undescribed species or a biologic form of U. tritici.

Ergot caused by Claviceps purpurea (Fr.) Tul.

The occurrence and estimated percentages of reduction in yield for rye ergot in the various states in 1920 is shown in the following tabulation:

Table 50. Estimated percentages loss from ergot of rye in 1920.

Percentage loss	States
1	Minnnesota, South Dakota.
.5	Wisconsin, Ohio, Pennsylvania.
.2	North Dakota, Kentucky.
t	New York, Virginia, West Virginia, Michigan, Indiana, Illinois, Iowa, Missouri, Arkansas, Nebraska, Utah.

Ergot was reported as occurring chiefly on volunteer rye in Virginia, Indiana, Wisconsin, and Nebraska; as less prevalent than normally or than in 1919 from Michigan, Illinois, Indiana, Iowa, and North Dakota; and as more prevalent than 1919 from Minnesota and Ohio. Bisby states that ergot occurs commonly on rye in Manitoba. Farmers will not bother with the salt brine treatment in Wisconsin, according to Vaughan, owing to the slight losses. In South Dakota ergot appears to have been rather severe as Evans reports a 15% loss in one field of 160 acres at Aberdeen.

In view of Seymour and McFarland's recent studies (Losses from rye ergot. Phytopath. 11: 41. 1921) it seems probable that losses from ergot of rye have generally been underestimated. They find, in addition to the loss represented by the actual number of sclerotia, that a larger percentage of blasted kernels and empty florets occur on ergotized than on normal spikes.

Stripe rust caused by *Puccinia glumarum* (Schm.) Eriks. & Henn.

This rust was reported on rye only from Oregon where it was said to be of only slight importance and less abundant than last year. It was thought to be rather generally distributed in the state, but as no special search was made its prevalence could not be determined.

BARLEY

Covered smut caused by *Ustilago hordei* (Pers.) K. & S.

Covered smut occurred to some extent in all sections where barley is grown. No comments as to marked differences in occurrence or severity as compared with 1919 were received but it is probably generally true that there was a slight reduction in severity in 1920. It was not unusually severe in any state, the highest estimated percentage reduction in yield for a state being 2% (Idaho, Kansas, and Tennessee). The estimated percentages of reduction in yield from covered smut are shown on the accompanying map together with those for loose smut. These losses are shown in bushels in Plant Disease Bulletin, Supplement 18, 1921.

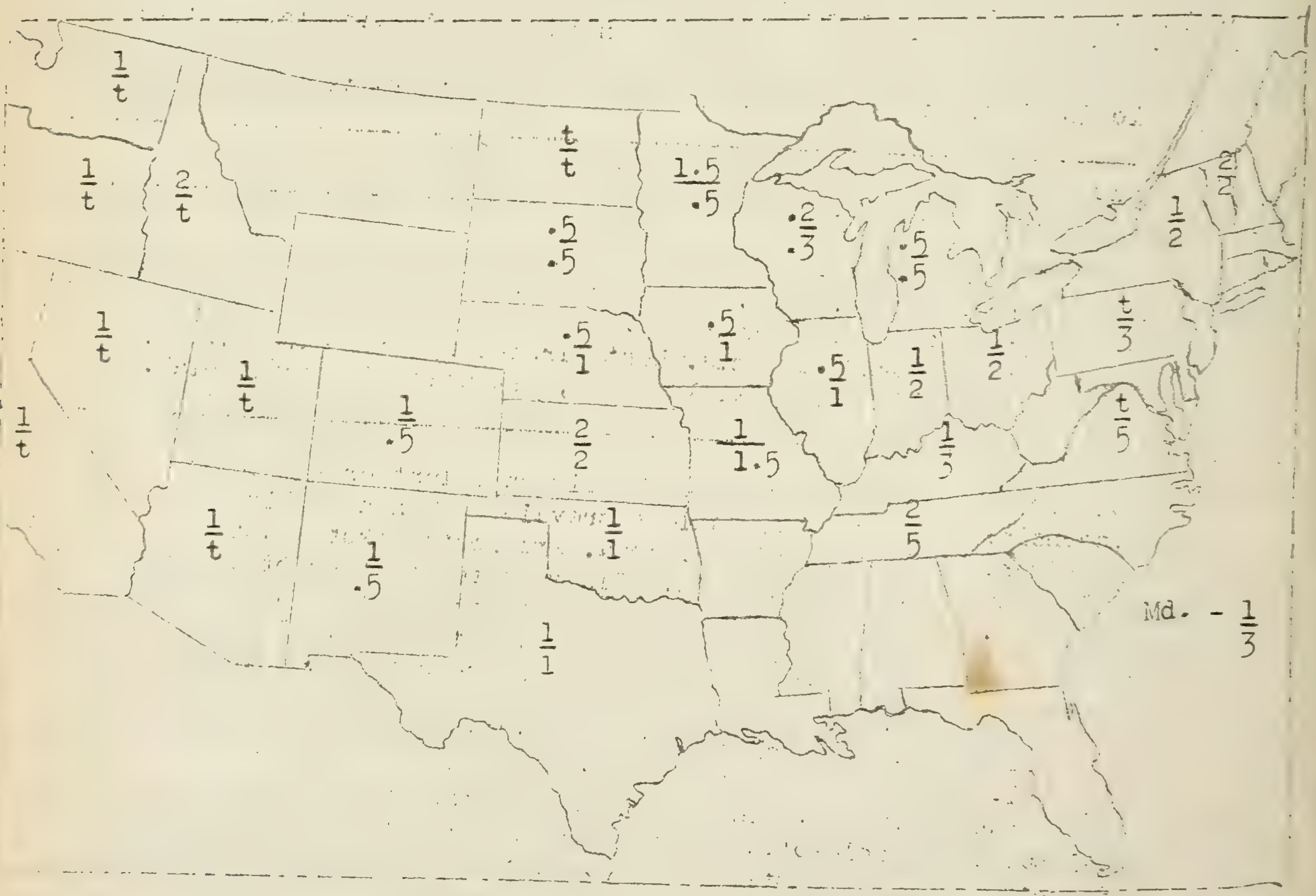


Table 29. Occurrence and estimated percentages of reduction in yield for covered and loose smuts of barley in 1920. The numerator shows percentage reduction in yield for covered smut, the denominator that for loose smut.

It will be noted in referring to the map (Fig. 29) that covered smut is shown to be more severe than loose smut in the Pacific and Rocky Mountain States, while this condition is reversed in a group of Eastern and Central States comprised of New York, Pennsylvania, Maryland, Virginia, Ohio, Indiana, Illinois, Iowa, Missouri, Kentucky, and Tennessee. In other states the two diseases appear to be of about equal importance. No data are available to show whether these differences, if they are real, are due to climatic differences or to other factors. It may be true that variations in the varieties of barley grown in these various sections are the important factors in determining relative prevalence and severity of the two smuts. Very little data on varietal susceptibility have been received.

Seed treatment of barley is said to be rather general in North Dakota, Wisconsin, and California. Lantz states that formaldehyde is used in Nevada with good results. Both the formaldehyde and copper sulphate-milk of lime treatments are used in California. Vaughan states that considerable barley seed is treated with the Cleland smut machine (formaldehyde) in Wisconsin. In North Dakota, according to Bolley, seed treatment appears gradually to eliminate both covered and loose smut.

Loose smut caused by Ustilago nuda (Jens.) K. & S.

Loose smut of barley was general throughout the country in 1920. It occurred in lesser amounts in the west, where state averages did not exceed a trace, than in the east where infection was more general and severe. The greatest losses were reported from the states east of the Mississippi River - Virginia and Tennessee 5%, Maryland, Pennsylvania, and Kentucky 3%, Vermont, New York, New Jersey, Ohio, and Indiana 2%. It is interesting to note that this is also the section where loose smut of wheat is most prevalent and severe. The relative severity of loose and covered smut in the country is shown in the following table as well as on the map included in the summary on covered smut. The range of severity of loose smut exceeded that of covered smut, the average percentage reduction in yield for all states from the former disease being 1.33% and that due to covered smut .88%. Very little information was obtained on severity in individual fields, varietal susceptibility, or weather relations. Gardner states that a few successful hot water treatment demonstrations were held in Indiana.

Table 51. Range of estimated average percentages of loss from loose and covered smuts of barley, 1920.

Disease	Number of states with									Average
	t	.2%	.3%	.5%	1%	1.5%	2%	3%	5%	percent
Covered smut	5	[illegible]		5	15	1	4			.88
Loose smut	8		1	5	5	1	6	3	2	1.33

Stripe caused by Helminthosporium gramineum Rab.

Barley stripe occurred to some extent in all sections of the country, except in the southern Atlantic States and the Gulf States from which no record of its presence was received. It was less severe in the upper Mississippi Valley

States, where it is usually an important factor in barley production, than in 1919 and average years. In Iowa, for example, where the percentage reduction in yield in 1919 was estimated at 5%, the 1920 estimate was 2%. In Wisconsin, Vaughan states that hundreds of acres were examined where no trace of stripe could be found. The loss here was estimated as a trace, compared with 1% in 1919 when it was reported as much less severe than for several years. The highest percentage of infection found in Wisconsin was 15% on low ground in Racine County. It was reported as very common in Tennessee, common and found in nearly all fields in Michigan, not common in North Dakota, severe where present in Utah but reported from only a few areas. It was observed in five counties in New York with the percentage of infected plants in individual fields ranging from a trace to 20%.

Table 52. Estimated percentages reduction in yield from barley stripe, 1920.

Average percentage loss	State
2	Iowa.
1	Minnesota, Michigan, Illinois, Indiana, Ohio.
.5	South Dakota.
t	Vermont, New York, Virginia, Tennessee, Wisconsin, Missouri, North Dakota, Nebraska, Oklahoma, Washington, Oregon, Idaho, Utah, Arizona, California.

It was first observed in May in Tennessee and California, May 31 in New York, and July 1 in Wisconsin.

Stem rust caused by *Puccinia graminis* Pers.

Definite occurrences of stem rust of barley in 1920 were reported from New York, Virginia, Indiana, Illinois, Wisconsin, Minnesota, Iowa, North Dakota, Nebraska, Kansas, Oklahoma, Texas, Colorado, Arizona, Utah, Idaho, and California. It was of slight importance in most of these states, occurring as mere traces with slight or no loss, except in Wisconsin, Minnesota, Iowa, and Arizona. It was about the same in severity in Wisconsin (3%) and Minnesota (5%) as in 1919, but was much more severe in Iowa where Melhus estimated a reduction in yield for the state of 17%. In Arizona as high as 4% actual loss was estimated. This disease along with leaf rust cut the barley yield by about one-third according to pathologists and agronomists in the Arizona Station. The rust on barley was reported as more severe in the vicinity of wheat in Wisconsin.

Leaf rust caused by *Puccinia simplex* (Koern.) Eriks. & Henn.

Leaf rust of barley was reported as occurring in a number of states in 1920 especially in the north-central, eastern, and southwestern parts of the country. It was said to be common in Vermont; general and very serious in Arizona; common, affecting 100% of the crop in Kentucky; and more prevalent than usual in Ohio. Apparently little or no injury resulted in most states and infection was chiefly slight and only occasional. In Arizona, however, this disease was apparently responsible for much damage according to J. G. Brown.

Reports of occurrence were received from the following states: Vermont, New York, Maryland, Virginia, Michigan, Ohio, Indiana, Kentucky, Tennessee, Illinois, Wisconsin, Minnesota, Iowa, North Dakota, Texas, Arizona, and California.

Scab (blight) caused by Gibberella saubinetii (Mont.) Sacc.

Scab was reported to occur on barley only from 11 states in 1920. It was of slight or no importance in all, no estimate of losses in excess of trace being received. This was in marked contrast to the season of 1919 when losses estimated at 3% in Iowa and South Dakota and 1% in Kentucky, Tennessee, and Missouri occurred. It was reported in 1920 as common or general in Kentucky, Tennessee, and Illinois, more than 1919 in Ohio and less than 1919 in Wisconsin. It was also reported to occur in New York, New Jersey, Virginia, Minnesota, Iowa, and Texas.

Net blotch caused by Helminthosporium teres Sacc.

In 1920 net blotch was reported from practically the same range as in 1919. It was reported as severe only in Wisconsin and Iowa. In Wisconsin, Vaughan states that it was more severe than in 1919 causing premature killing of the leaves with 75% injury and an estimated loss of 5%. In Iowa Melhus estimates 60% of the crop injured with a loss of 6%. Definite loss probably occurred in Ohio also where Selby placed the crop injury at 20%. The disease was also reported to occur, with slight or no loss, in Vermont, New York, Indiana, Minnesota, Idaho, and California.

Spot blotch caused by Helminthosporium sativum (P.) K. & B.

Spot blotch of barley was reported in 1920 from Vermont (occasional), Indiana, New York (two counties), Illinois (trace), Texas, California, and Idaho (very rare). It was more prevalent and severe in Wisconsin, where 25% of the crop was reported injured with an estimated loss of 2%, and in Minnesota which also reported 25% of the crop injured with loss amounting to about 1%. Seedling losses were said to be severe in a few cases in Wisconsin, and in North Dakota it was said to be the cause of a root blight of seedlings similar to the seedling blight of wheat. According to Vaughan no treatment tried had any effect on the disease.

Scald caused by Rhynchosporium secalis (Heins.) Davis.

Scald (Rhynchosporium blight) of barley was noted as occurring in Indiana (Lafayette), Kansas (trace), and Idaho (rare) It was less severe than usual in California, where it sometimes causes severe local losses. In Wisconsin this fungus was observed on Dactylis glomerata and Bromus inermis in addition to barley and rye (Charles Drechsler Occurrence of Rhynchosporium on Dactylis glomerata and Bromus inermis. Phytopath. 11: 42. 1921). It was present on Bromus in about the same abundance as on nearby plants of barley and rye, but was less plentiful on Dactylis.

Other diseases.

Anthracnose of barley (Colletotrichum cereale Manns) was reported as of minor importance from five states - New Jersey, Ohio, Wisconsin, Kentucky, and Texas.

Ergot of barley (Claviceps purpurea (Fr.) Tul.) occurred as a trace in Wisconsin, Minnesota, North Dakota, and Iowa.

Powdery mildew (Erysiphe graminis DC.) of barley occurred in rather severe form in New York and Ohio. As much as 80% infection was noted in Tompkins County, New York. It was said by Thomas to have occasioned more loss than rust in Ohio.

Stripe rust (Puccinia glumarum (Schm.) Eriks. & Henn.) was not reported on barley from any state in 1920.

Blight (Septoria sp.). Weniger reports one field of barley near Jamestown, North Dakota, severely attacked by a species of Septoria.

OATS

Smut caused by Ustilago avenae (Pers.) Jens. and U. levis (K. & S.) Mag.

The smuts of oats occurred as usual throughout the country, and were practically coextensive with the cultivation of oats with little apparent variation in severity in the different section. They were also found by E. C. Stakman at Anchorage and Skagway, Alaska. By comparison with the estimates for 1919 and from comments of collaborators it seems evident that as a rule there was slightly less smut in 1920 than in 1919 and considerably less than in years prior to 1919; and, further, that the rather general practice of seed treatment has been the principal factor in this general reduction in severity.

No unusually high percentages of infection were reported, the highest in individual fields being 25% in New York and Maryland, 15-20% in Vermont, 10% in West Virginia and Tennessee, and 6% in Wisconsin. In Virginia there was little smut in winter oats which was generally a very poor crop owing to winter killing, but in spring oats the disease was general. The accompanying map shows the occurrence and estimated percentages of reduction in yield for the oat smuts in 1920. The estimated losses summarized in bushels are given in Plant Disease Bulletin, Supplement 18, 1921. The range of the reported percentages reduction in yield are shown below. The figures under the percentage columns indicate the number of states with that average per cent.

Table 53. Range of estimated percentages reduction in yield of oats from smut, 1920.

Number of states with						Average per cent in all states.
1%	1.5%	2%	3%	4%	5%	
5	4	15	10	2	8	2.7

A special question was addressed to collaborators asking for reports on recent experiences in treating seed oats by the wet and dry methods or modifications. It is understood in these reports that reference to the wet or sprinkle method indicates the 1-320 concentration (1 pint to 40 gallons); the dry method equal parts, 1-1. Excerpts from these reports are given below.

New York: "The amount of oat smut in the state has been reduced very much since the Haskell dry method of treatment has been recommended. At least 75% of the growers practice seed treatment either every year or as often as smut begins to show. At least two seed firms treat most of the oats seed which they sell. There are still a few individual fields with large amounts of smut...... but a large percentage of the fields show none or merely a slight trace." (Chupp)

"Counts in 10 fields in Oneida County showed 1% smut in treated fields, and 12% in untreated fields. In Wyoming County, 8 treated fields had .8% of smut and 19 untreated fields 11.1%." (Data supplied by Chupp)

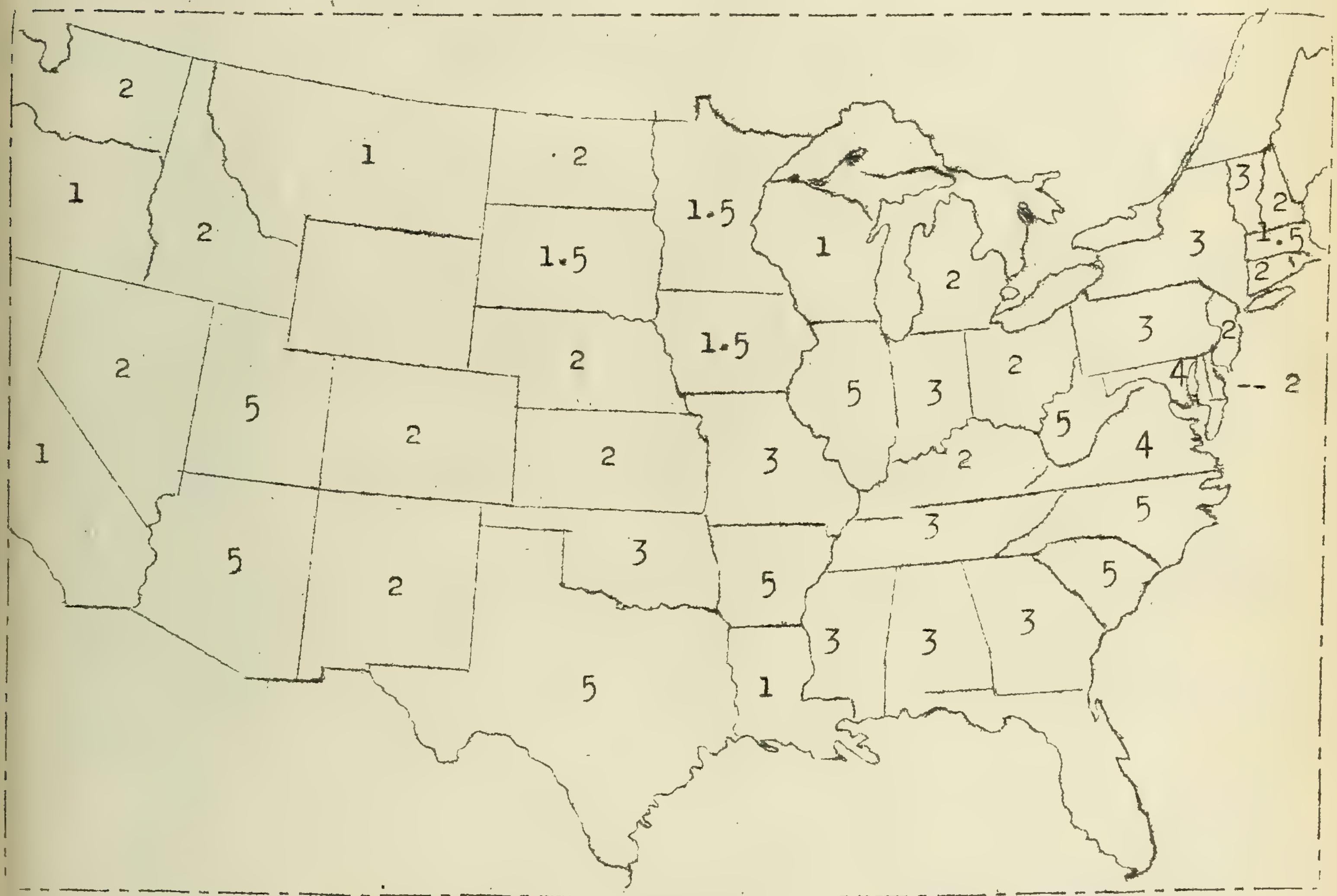


Fig. 30. Estimated percentages of reduction in yield from smuts of oats, 1920.

Pennsylvania: "Seed treatment for oat smut is quite universally practiced, particularly in the counties where county agents have held forth for a number of years. In many of the counties 75% of the seed oats is treated. This work is put over largely by propaganda through newspapers, schools, banks, druggists, etc. Material and directions are put in all trading centers through the counties early enough in the spring to give every farmer an opportunity to get the work done. Several reports have come in indicating injury from the dry method. On investigation it is usually proved that directions were not followed closely." (Nixon)

Tennessee: "Formaldehyde wet method used. Only a small percentage of our farmers treat oats for smuts." (Essary, Kurtzweil, and Hesler)

Mississippi: "The wet method is practiced by a few farmers." (Neal)

Arkansas: "Very little seed is treated." (Elliott)

Michigan: "The dry method is still successful." (Coons)

Ohio: "the seed treatment for oat smut as generally has been the formaldehyde sprinkling treatment, or the wet method. The dry method has resulted in injury to germination, though the amount of injury is very much less than has been noticed where the method has been applied to wheat." (Selby)

Illinois: "The number of farmers who treat their oats for smut is increasing every year. The dry method has not caused satisfactory results in every case. Some difficulty is experienced in making a satisfactory distribution of the formaldehyde without a consequent lower germination in some cases and failure to prevent smut in others. We like the 1-80 mixture using one pint of the solution to each bushel of oats. This permits more uniform distribution and does not wet the oats enough to make it necessary that they be dried before seeding." (George H. Dungan)

Wisconsin: "No reports of the dry method. County agents and farmers are well satisfied with the results from the Cleland smut machine." (Dickson)

Minnesota: "Both the wet and dry methods have proved effective and, so far as we have been able to determine, both have been safe."(Stakman)

North Dakota: "Have not advocated the dry method for this state. It is not satisfactory under our dry seed and atmospheric conditions." (Bolley)

South Dakota: "Seed treatment of oats is fairly general." (Evans)

Indiana: "Use of dry formaldehyde on the increase. Good results." (Gardner)

Nevada: "About fifty per cent of the farmers treat with formaldehyde." (Lantz)

After calling attention to a misquotation in the 1919 report (Plant Disease Bulletin, Supplement 8, May 1, 1920; page 53, line 5 under Idaho, - 1 pt. to 10 gal. should read 1 pt. to 10 pts.), Hungerford makes the following statement with reference to Idaho:

"This modified dry method (1 pint formaldehyde to 10 pints of water) has been used now for three years and has been satisfactory every year. By using ten parts of water to one of formaldehyde it is much easier to

> cover all the grain uniformly and still there is not enough of the solution to wet the oats to any appreciable extent. The use of this weaker solution is also much better in that the fumes of the formaldehyde are not so strong and unpleasant for the operator. In the tests this year three plots of one-fortieth acre were planted with Swedish Select oats which was very badly smutted. No. 1, untreated smutted seed gave 30% smut; No. 2, treated with the dry method, one pint formaldehyde to one pint of water, gave complete control; No. 3, treated with the modified dry method, one pint formaldehyde to ten pints of water, gave perfect control also."

G. M. Reed in extensive tests with loose smut on a large number of varieties of species of Avena (Missouri Agr. Exp. Sta. Res. Bul. 37. July, 1920) has obtained no infection with *Avena brevis* (3 varieties), *A. strigosa* (3 varieties), *A. sativa* var. Black Mesdag and var. *nigra*. Most of the varieties of *A. sterilis*, especially Burt, Early Ripe, Fulghum, and Selection gave very low percentages of infection. The *A. nuda* group proved highly susceptible. In general the different species and varieties reacted in the same way to the covered smut as they did to loose smut.

Stem rust caused by *Puccinia graminis* Pers.

Stem rust of oats was quite localized in 1920. In the Atlantic States it was reported from Vermont, Massachusetts, New York, and West Virginia, but occurred only as traces. In the South it occurred in Georgia and Alabama, being rather severe in the former state (2% estimated reduction in yield) and of slight importance in the latter. It was reported from the following North Central States: Michigan, Indiana, Illinois, Wisconsin, Iowa, Minnesota, North Dakota, and South Dakota. It was of about average severity in these states except in South Dakota where Evans reports it very general and severe with an estimated loss for the state of 10%. The other states in this section reported losses as follows: 1%, North Dakota, Minnesota, Michigan; .5% - Iowa and Wisconsin. It occurred in Idaho, Nevada, Utah, and Colorado, but in slight amounts, and caused severe injury in California, Arizona, and Texas. Complete data on losses are given in Plant Disease Bulletin, Supplement 18, 1921.

The following statement is quoted from Bolley with reference to conditions in North Dakota;

> "Seldom seen this year. We do not know whether the apparent disappearance of stem rust of oats is being brought about by the destruction of the barberry or not, but for the past three years, even when the stem rust is abundant on wheat, oats have seldom suffered severely. Again this may all be due to drought periods coming on at the proper time."

Crown rust caused by *Puccinia coronata* Cda.

The observed geographic range and estimated percentages of loss of crown rust of oats in 1920 are shown on the accompanying map. The disease, as usual, was especially prevalent and destructive in the southern states. It was about the same in prevalence and severity in most of these states as in previous years, but was unusually severe in Louisiana, Arkansas, and Tennessee. Edgerton states that nearly 100% of the crop was affected and that even the resistant varieties showed considerable rust in Louisiana. It was less severe as a rule in the northern Mississippi Valley than in previous years. Definite occurrence in the West was reported only from California where the rust was not important. It seems quite evident that crown rust overwinters on fall sown oats in the South. Edgerton reports the presence of rust on oats in Louisiana in January. Bisby states that while crown rust was fairly common in Manitoba it caused little loss to the oats crop. He noted the first aecia on Rhamnus on June 19, and the first uredinia on oats in July.

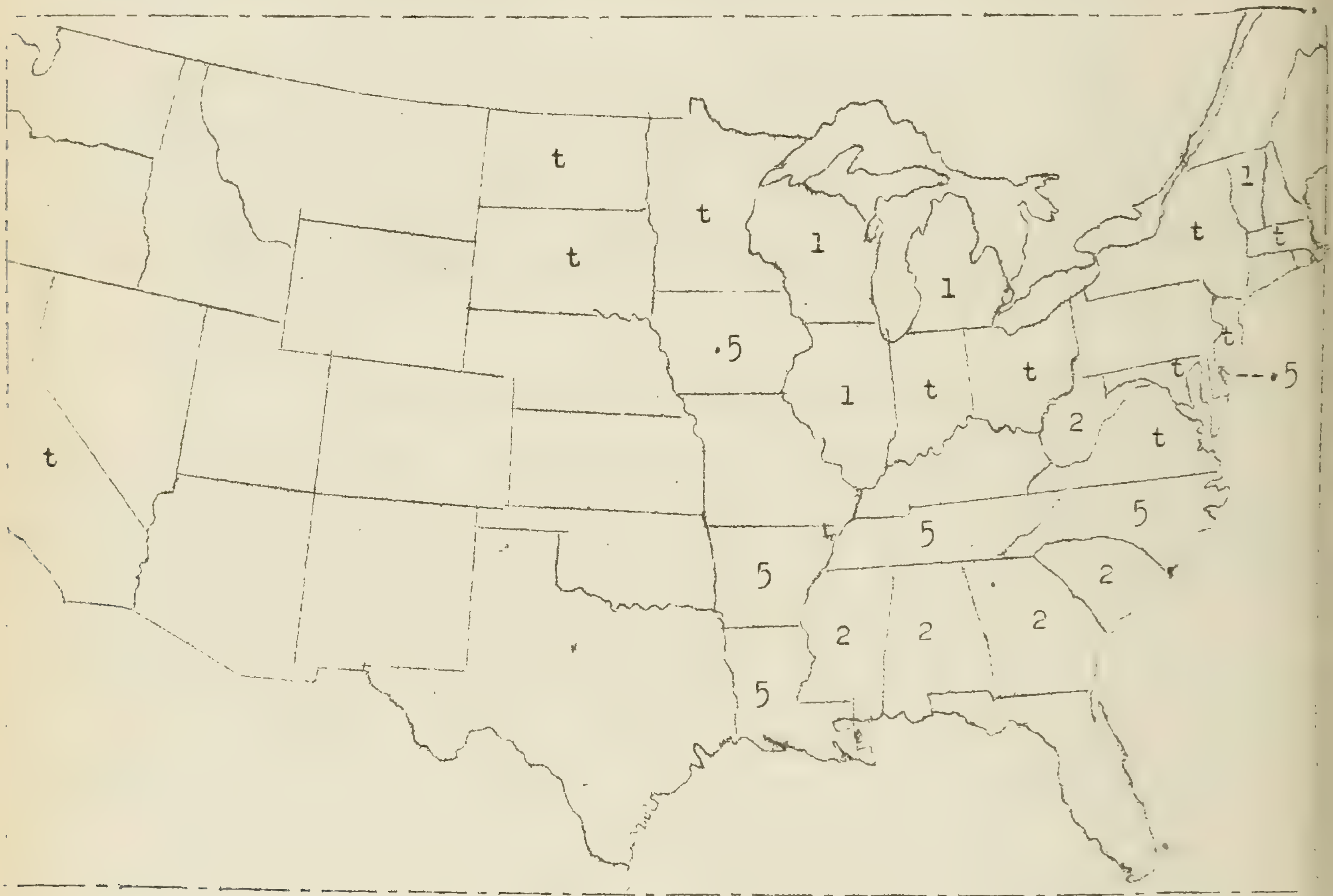


Fig. 31. Occurrence and estimated percentages reduction in yield of oats from crown rust, 1920.

Halo-blight caused by Bacterium coronafaciens Elliott = Pseudomonas avenae Manns.

Halo-blight of oats was reported from more states in 1920 than in any previous year. The indications are that it occurs to some extent throughout the country but that it is quite dependent on favorable climatic conditions for vigorous development. The fact that the organism is seed borne would provide for its introduction generally. It was reported as fairly common or general in Delaware, Indiana, and Arkansas. It also occurred in slight amounts in New York, Ohio, Illinois, Michigan, Wisconsin, North Dakota, South Dakota, Kansas, Idaho, and California. It was said to have caused some loss in Delaware but, according to reports, was of slight or no importance in the other states. In Wisconsin Vaughan states that mild infection occurred when the plants were in the boot but that they appeared to outgrow it later. Elliott states (Jour. Agr. Res. 19: 139-172. May 15, 1920) that the 1-320 formaldehyde treatment as used for oat smut checks halo-blight but does not entirely control it, while the dry heat treatment, 100° C. for 30 hours, is fully effective. She finds differences in varietal susceptibility but states that these are not marked when the disease is severe.

Anthracnose caused by Colletotrichum cereale Manns.

Reports of the occurrence of anthracnose on oats in 1920 were received from only six states. In none was it of more than very minor importance. It was common in New Jersey, Delaware, and Michigan, slight in Ohio except on plots in continuous oat culture where 100% infection was noted, and it was reported occurring only in traces in Wisconsin and Minnesota.

Scab (blight) caused by Gibberella saubinetii (Mont.) Sacc.

The Fusarium blight or scab of oats was reported in 1920 from Delaware, Ohio, Illinois, North Dakota, and Texas. It was of slight importance, being much less severe than in 1919. A loss of .5% was estimated in Texas.

Blast (sterility) causes not determined.

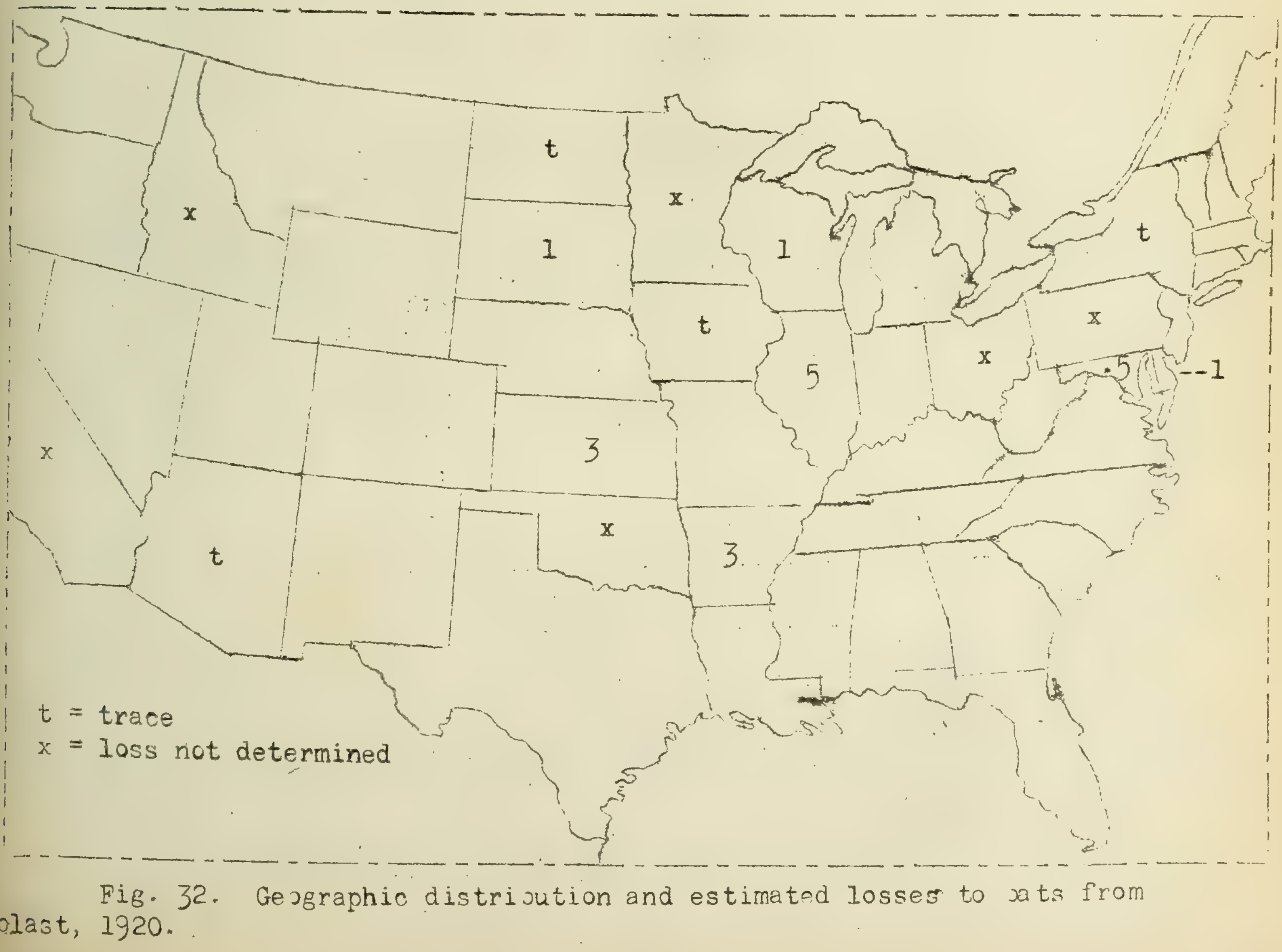


Fig. 32. Geographic distribution and estimated losses to oats from blast, 1920.

The occurrence of blast in oats and the estimated percentages of loss in 1920 are shown on the accompanying map. It occurred rather generally over the country, being especially severe in Illinois, Kansas, Arkansas, Wisconsin, South Dakota, and California. It was also reported from Pennsylvania (very common in Sullivan County), Delaware (general), Oklahoma (present in many fields), Idaho (common), Arizona (chiefly in the Salt River Valley), and as slight in Iowa, Ohio, and North Dakota. Vaughan gives the following for Wisconsin:

> "More than in 1919, 25% of the crop injured. Highest loss estimated was 15% in Brown County, six cases 5%, one case 4%, one case 2%, fourteen cases trace. Thought to be associated with heavy rains when plants were entering the flowering stage."

Other diseases.

Red leaf of oats, cause not definitely determined, was reported from Michigan, Idaho, and California. The injury in Idaho is thought by Hungerford to be due to frost.

Seedling blight. Specimens of oat seedlings were received on May 10, from R. C. Rose, who collected the material south of Fort Smith, Arkansas. The lower part of the seedlings were covered with mycelium and sclerotia of *Sclerotium rolfsii*.

Burning of young oats, due to hot weather, occurred in occasional fields in Michigan according to Coons.

CORN

Smut caused by *Ustilago zeae* (Beck.) Ung.

Corn smut occurred in every state from which reports were received in 1920. It is no doubt coextensive with the culture of corn in the United States, but varies considerably in prevalence and severity in the different sections. Corn smut was of slight importance in the extreme northern states, with the exception of Vermont, and in the Northwest. It was general in the Eastern, Southern, and Central States, probably causing 1-2% crop loss, and was most prevalent and severe in states west of the Mississippi River and in the Southwest. The estimated percentages of loss are shown on the accompanying map and also in the following tabulation.

Table 54. Estimated losses from smut of corn, 1920.

Percentage loss	States
8	Kansas.
5	Nebraska, Colorado, Arizona.
3	Vermont.
2	North Carolina, South Carolina, Georgia, Kentucky, Indiana, Illinois, Missouri, Arkansas, Texas, Oklahoma, New Mexico, California.
1	New York, Pennsylvania, New Jersey, Maryland, Delaware, Virginia, West Virginia, Ohio, Tennessee, Alabama, Mississippi, Minnesota, Iowa, South Dakota, Utah.
.5	Massachusetts, Connecticut, Michigan, Louisiana, North Dakota.
t	Wisconsin, Wyoming, Idaho, Washington, Nevada.

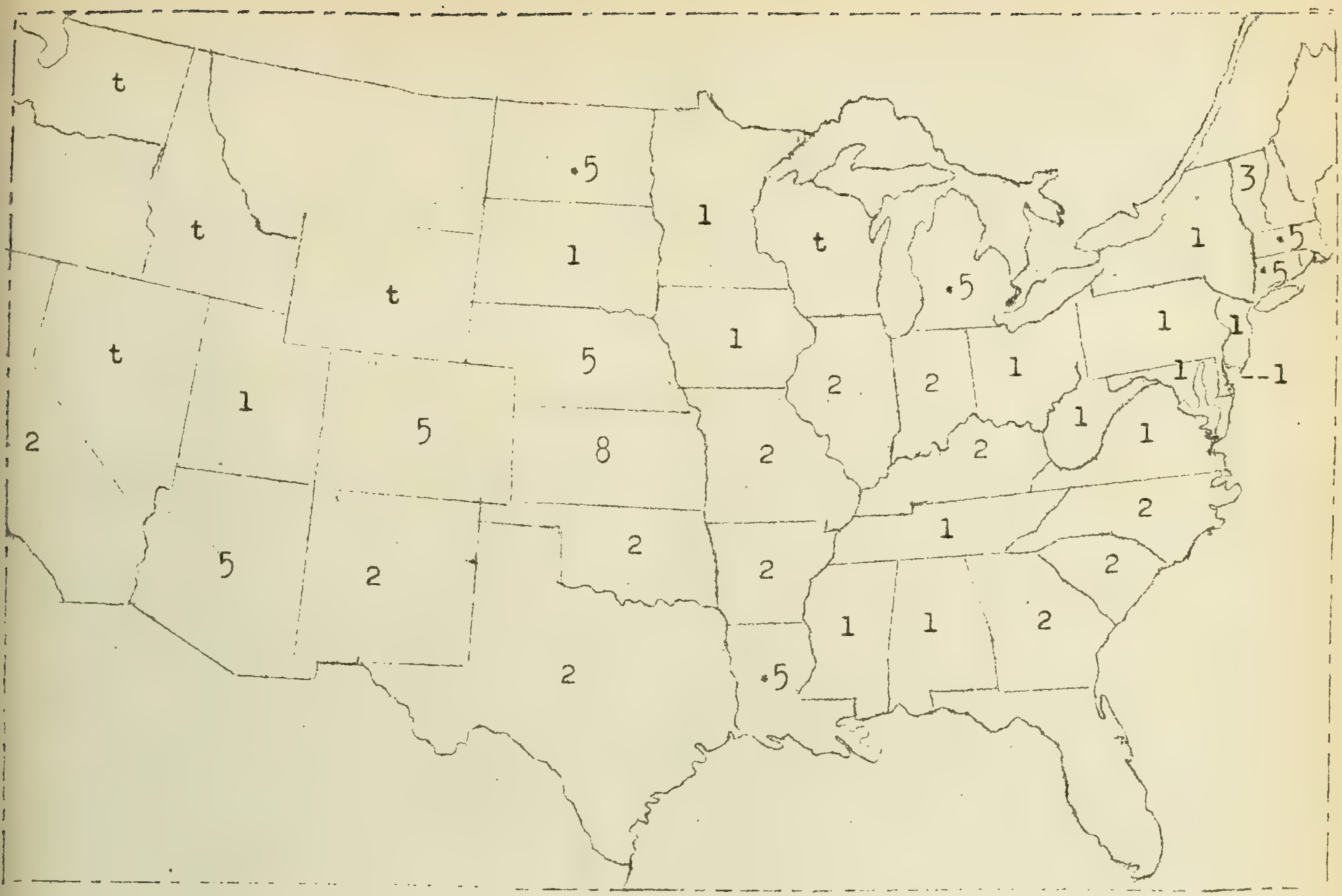


Fig. 33. Occurrence and estimated percentages of loss from corn smut in 1920.

Corn smut was reported as more severe than previously in Vermont, Indiana, Kansas, Arkansas, and Colorado, and as less severe in Wisconsin, North Dakota, Iowa, and Louisiana. More infection on the tassels than usual was reported from Ohio. Comments received on severity are as follows:

Vermont: "More than I have ever seen here." (Lutman)

New York: "Present in small amounts throughout the state. An epidemic, however, occurred in Suffolk County, Long Island. Counts of 5,000 plants were as follows:
12.95% of plants had smut infection
3.13% of ears had smut infection
1.5% of ears were destroyed by smut." (Kirby)

Kansas: "Very common. Many fields showed 50-80% affected plants." (Melchers)

Colorado: "Reported by the Agricultural Agent of the Denver and Rio Grande R. R. as causing the greatest loss along his line in ten years." (Learn)

Utah: "Appears to be rapidly increasing in severity." (Richards)

Sweet corn is said to be more susceptible in Maryland and Indiana, while Wisconsin also notes that more smut is found in sweet corn where no attention is given to rotation, and that heavy growing varieties like Evergreen show more smut than the smaller early varieties. McClintock states that in Georgia ear infection is most important in sweet and pop corn. It was noted in Tennessee that smut is generally less damaging to late corn, while it was observed in Wisconsin to be more prevalent in late planted fields. McClintock observed an old field, in corn for the first time in years, that had about 35% of smut on various parts of the plants.

Root, stalk, and ear rots caused by Gibberella spp. and Fusarium spp.

These troubles, in all or some of their various forms, were present, as in 1919, in practically all of the states east of the 100th meridian. Reports of one case in Washington, and very slight infection in California, were the only reports received from the West. The injury was in most states practically the same as in 1919, being evidently more severe in Kansas, Nebraska, and South Dakota, and it was somewhat less so in Wisconsin, New Jersey, and Virginia. In Kansas, the disease was especially severe in Labette County, where some fields showed as much as 75-80% down stalks, according to Melchers. Thomas states that some fields in Ohio showed losses as high as 90%, Bolley noted two severe cases in North Dakota, and Evans in South Dakota reported two badly infested fields where few ears were expected to mature. Stakman states that this disease is unimportant in Minnesota as a rule. The ear rots seem to be especially prevalent

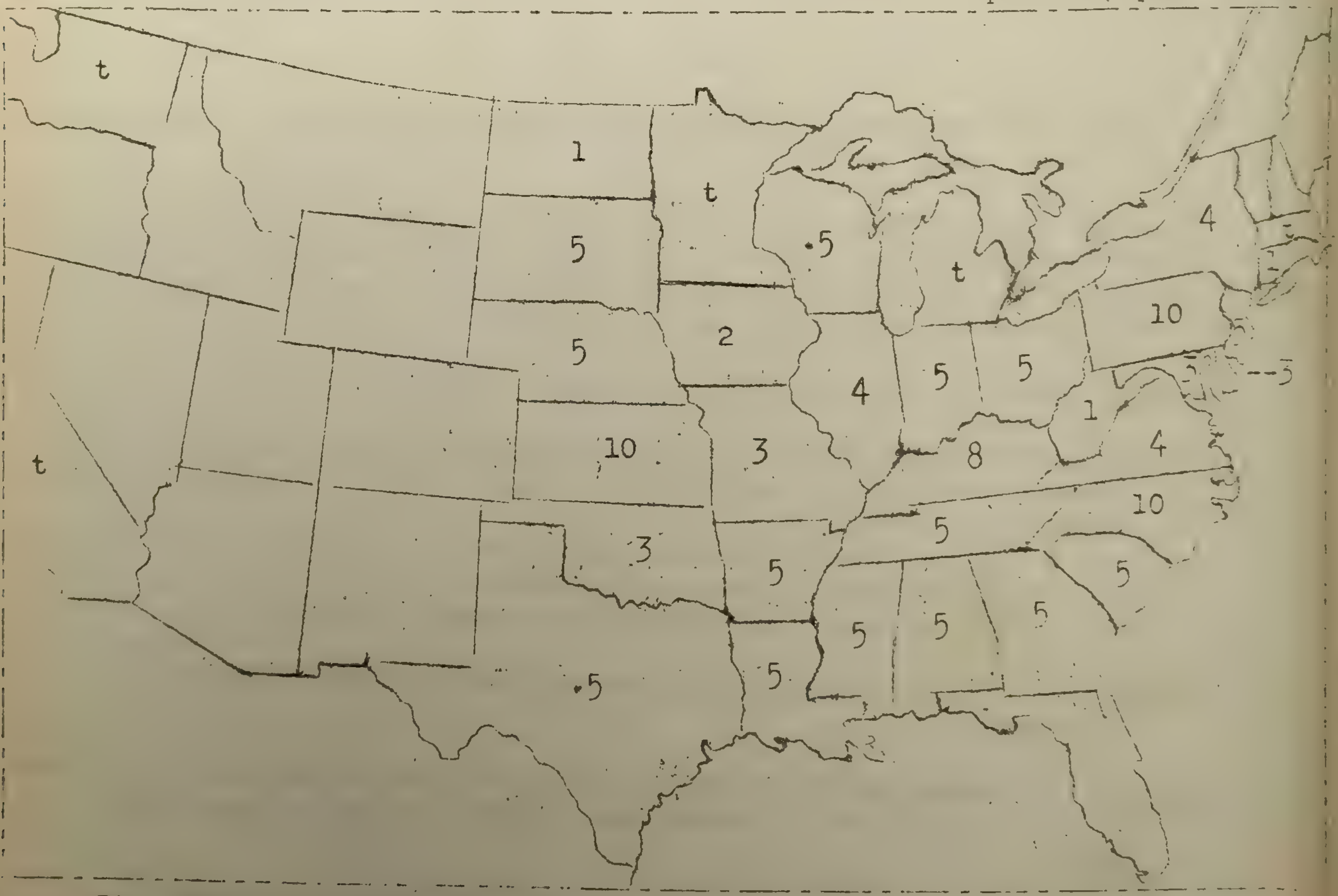


Fig. 34. Occurrence and estimated percentages of loss from root, stalk, and ear rots of corn in 1920.

in the South. Valleau finds in Kentucky that approximately 8% by weight of the ears harvested are made up of rotten ears. That ear rots may also be severe in the North is shown in the following data supplied by Kirby from Suffolk County, New York. He found in field counts of Luce's Favorite corn that 16% of the ears had Fusarium rot throughout the ear, 48% had rot only on the tip, and 36% were free from rot. Neal states that in Mississippi missing stalks, down stalks and rootrot symptoms are found throughout the state, but that the ear rots are met with most frequently. Elliott notes that ear rot is found on most worm-eaten ears. The occurrence and estimated percentages of loss for 1920 are shown on the accompanying map, while losses, summarized in bushels will be given in Plant Disease Bulletin, Supplement 18, 1921.

With reference to varietal susceptibility Hoffer notes that sweet corn is more susceptible than dent corn, while Trost and Hoffer (Phytopath. 11: 32-34. 1921) have found that ears with starchy kernels produce plants that are more susceptible than those from horny kernels. In experimental plantings they obtained a decrease of 4% in initial stand and of 16.4% in yield in rows planted from ears with starchy kernels, as compared with those planted from ears with horny kernels. Valleau notes that individuals within a variety exhibit striking resistance to root rot.

Very satisfactory results are being obtained in Indiana in the separation of diseased and disease-free ears by means of the improved rag-doll germinator and this method is being put into commercial practice in Indiana and Illinois in particular. In experimental plantings of Fusarium-infested ears which germinated 100%, Duddleston and Hoffer (Phytopath. 11: 33. 1921) found an average decrease of 11.1%, or 8 bushels per acre, as compared with the general fields planted with apparently disease-free ears. In work with sweet corn Smith and Hoffer (Phytopath. 11: 34. 1921) find three profitable lines of control: (1) the selection of seed corn in the field from apparently healthy stalks; (2) artificial drying by heat immediately after harvesting; and (3) selection of ears on the germinator.

The following account of the Utility Corn Show held at Galesburg, Illinois, is by J. R. Holbert and is quoted from the Cereal Courier 13: 3. January 15, 1921.

> "There were 119 entries from more than 20 counties. These included more than 2,000 ears of corn. Many of the fine looking entries were very badly infected with both Diplodia and Fusaria. Many of the entries contained from two to four dead ears. Others that contained no dead kernels were frequently badly diseased. No sample was entirely disease-free, even the ten ears that won sweepstakes contained one diseased ear. The other nine were outstanding in general appearance, vigor and vitality, and freedom from diseases and were of the type that we have been finding to be characteristic of our high-yielding, disease-free corn."

Bacterial wilt caused by Aplanobacter stewartii (Sm.) McC.

This disease was reported in 1920 from New York (trace in field corn on Long Island), Maryland (rather common), Virginia (common in home gardens), Ohio (reported in two or more localities without serious losses), Indiana (rare), Kentucky (in small-growing varieties of sweet corn, following root rots caused by Fusarium moniliforme), Arkansas (only one report, from Sebastian County), and Texas (present in slight amounts in west Texas, but not seen in east), F. V. Rand states that wilt is usually of slight importance in commercial fields of corn growm for canning owing to the rather general use of two varieties, Stowell's

Evergreen and Country Gentleman, both of which show considerable resistance to the disease. Temple notes that Country Gentleman is resistant and Golden Bantam susceptible in Maryland, and Fromme states that wilt is found commonly on Golden Bantam in Virginia.

Brown spot caused by Physoderma zeae-maydis Shaw.

Physoderma occurred practically throughout the range that had been determined by survey work in previous years. A noteworthy feature of the season was the unusual severity of the disease in eastern Nebraska. Goss reported it especially prevalent near Lincoln with considerable damage resulting from the breaking over of stalks. The severe occurrence of the disease was associated with heavy rainfall. The relation of the disease to moisture and temperature was shown, as formerly, by especial prevalence in river bottoms. Losses of about 1% were experienced in North Carolina, South Carolina, Georgia, Alabama, and Louisiana, and smaller losses in Mississippi, Arkansas, Missouri, Nebraska, Tennessee, and Kentucky.

Rust caused by Puccinia sorghi Schw.

Corn rust was reported in 1920 from practically every state east of the 100th meridian and from no state west of this line. It was in general very common in the section in which it occurred but was generally considered to be of slight importance with very slight or no loss except in Mississippi and Louisiana where losses were estimated at 1%. As a rule all varieties were said to be affected although Indiana reports more on sweet corn. A varietal test of susceptibility by Fromme and Wingard in Virginia was reported as follows:

> "A number of varieties of corn, both sweet and field, were inoculated in the field and compared for varietal susceptibility. All became heavily infected and no marked variations existed."

Weber in studies with corn rust at Wisconsin (G. F. Weber. Phytopath. 11: 31 1921) finds that urediniospores kept on corn leaves out of doors failed to germinate after December. He found some variation in susceptibility with greenhouse inoculations on seven species of corn.

Head smut caused by Sorosporium reilianum (Kühn) McAlp.

Head smut was reported from Washington as less prevalent than in 1919 and known only from the vicinity of Pullman, and also from California. In the latter state W. W. Mackie reported that the disease has spread since last year in the delta region near Stockton and that in Napa Valley it has become severe with reports of 40% damage.

Mosaic, cause unknown.

Corn mosaic was reported in 1920 from Louisiana and Georgia where it had previously been reported in 1918 as "frenching". It was said to be more prevalent than previously in both of these states, but in general injury was slight. Edgerton states that the disease was present throughout the season, which was especially wet, and that 100% affected plants were observed in some fields. When severe, the disease prevents ear development. Brandes (Jour. Agr. Res. 19: 517-521. Aug. 16, 1920) has found corn mosaic to be identical with that of sugar cane and sorghum as shown by inoculation experiments. He has also observed the same disease in Porto Rico and states that it is similar to mosaic of corn as reported in Hawaii and Guam.

Other diseases.

Bacterial root and stalk rot caused by Bacterium sp. This disease which, as described by Rosen (H. R. Rosen. A bacterial root and stalk rot of field corn. Abstract Phytopath. 11: 32. 1921) affects the roots, stalks, and leaves of both field and sweet corn was reported as severe locally in Arkansas. Death of 20 to 30% of the stalks is reported in some cases.

Leaf blight of sweet corn, cause probably bacterial, is reported by Hungerford as present in gardens in northern Idaho and found only on Golden Bantam.

A bacterial leaf spot, cause unknown, reported from Iowa as less prevalent than in 1919.

Leaf sheath spot caused by various species of fungi-reported from Iowa as present on nearly all plants with a trace of loss.

Leaf blight caused by Helminthosporium sp., reported from New Jersey (common but not important) and Tennessee (more than in 1919, 90% of the crop injured, slight loss).

Downy mildew caused by Sclerospora philippinensis. Very complete accounts of the occurrence, severity, host ranges, and life history of this important disease, as it occurs in the Philippines, have been given by W. H. Weston in several papers.

Ear rot caused by Diplodia sp., reported from New York (about .01% found in Suffolk County, none observed at any other place), Tennessee (causing some damage, especially after heavy rainfall of more than 11 inches in August), and Ohio (more than usual, 1% estimated loss in the state).

RICE

Blast caused by Piricularia oryzae Br. & Cav.

Blast (rotten-neck) of rice was reported by collaborators from Mississippi and Louisiana. It was found in Mississippi in three counties, Pearl River, Lauderdale, and Oktibbeha. Neal reports one field of 30 acres in which the infection was 40% and estimates the loss in the state at 4-5%. In Louisiana the disease is said to be common but losses are estimated to be less than 1%. This disease has also been reported previously from Arkansas, Texas, Alabama, Florida, and South Carolina.

Straighthead (non-parasitic).

Straighthead was reported from Arkansas and Louisiana and occasioned considerable loss in both states. It was said to be especially prevalent and severe in Louisiana in 1920, especially in the river district where a large amount of new land had been put into rice. The loss in the state was estimated at 2-4%, while that in Arkansas was placed at 1-2%. Tisdale has recently reported (Rice straighthead and its control. Abs. in Phytopath. 11: 42-43. 1921) that the disease is caused by the exclusion of air in applying water which prevents the formation of secondary roots and root hairs. It is especially prevalent on virgin soil and soil that has been in dry land crops previously. The development of this condition may be prevented by draining the soil at certain times during the irrigation period to permit soil aeration.

Smut caused by *Tilletia horrida* Tak.

No reports of the occurrence of this smut of rice were received from collaborators in 1920. It was reported in 1919 by W. H. Tisdale as having occurred to a slight extent in Louisiana.

Other diseases.

Leaf spot caused by *Cercospora* sp., reported by Edgerton as common in Louisiana but causing slight loss.

Seedling blight caused by *Sclerotium rolfsii* Sacc. was observed by W. H. Tisdale at Crowley, Louisiana in 1919 as destructive to germinating seed and young seedlings. He reports that irrigation checks the disease and that cultivation reduces the amount of the fungus in the soil (Two Sclerotium diseases of rice. Phytopath. 11: 42. 1921).

Stem rot caused by *Sclerotium oryzae* Catt.? was found in 1920 by W. H. Tisdale (l.c.) as a serious disease in Louisiana on Early Prolific and other varieties. The stems are attacked at the water line causing lodging and failure of grain to fill normally.

FLAX

Wilt caused by *Fusarium lini* Bolley.

Flax wilt was reported in 1920 from Michigan (first record for the state according to Coons), Wisconsin, Minnesota, North Dakota, South Dakota, and Montana. C. S. Reddy reported finding the disease in three counties in Michigan - St. Clair (Yale), Sanilac (Applegate, Crosswell, and Peck), and Ingham (East Lansing). It usually occurred in slight amounts but was sometimes severe in spots in the fields. It was found in Wisconsin only on the plots at Madison and was general in Minnesota, about as in average years, with an estimated loss in the state of 7.5%. Bolley states that in North Dakota the disease was somewhat less prevalent than formerly but was destructive as usual on old flax-cropped areas where non-resistant varieties are used. He estimates the loss in the state at about 5%. Evans states that the disease was present at Brookings, South Dakota on experimental plots but none was found in numerous fields examined in the north-central part of the state. W. E. Brentzel reports as the result of a survey in Minnesota, North Dakota, and Montana (Cereal Courier 12: [illegible], Aug. 20, 1920) the finding of flax wilt as far west as Plentywood, Montana, and Dickinson and Williston, North Dakota. Further west at Moccasin and Havre, Montana, no wilt was found in any of the fields, even on land that had been in flax continuously for five years. Bolley's resistant selections are reported as satisfactory on wilt infested soil, especially N. D. R. No. 114. The accompanying map shows the occurrence of flax wilt as reported to the Plant Disease Survey.

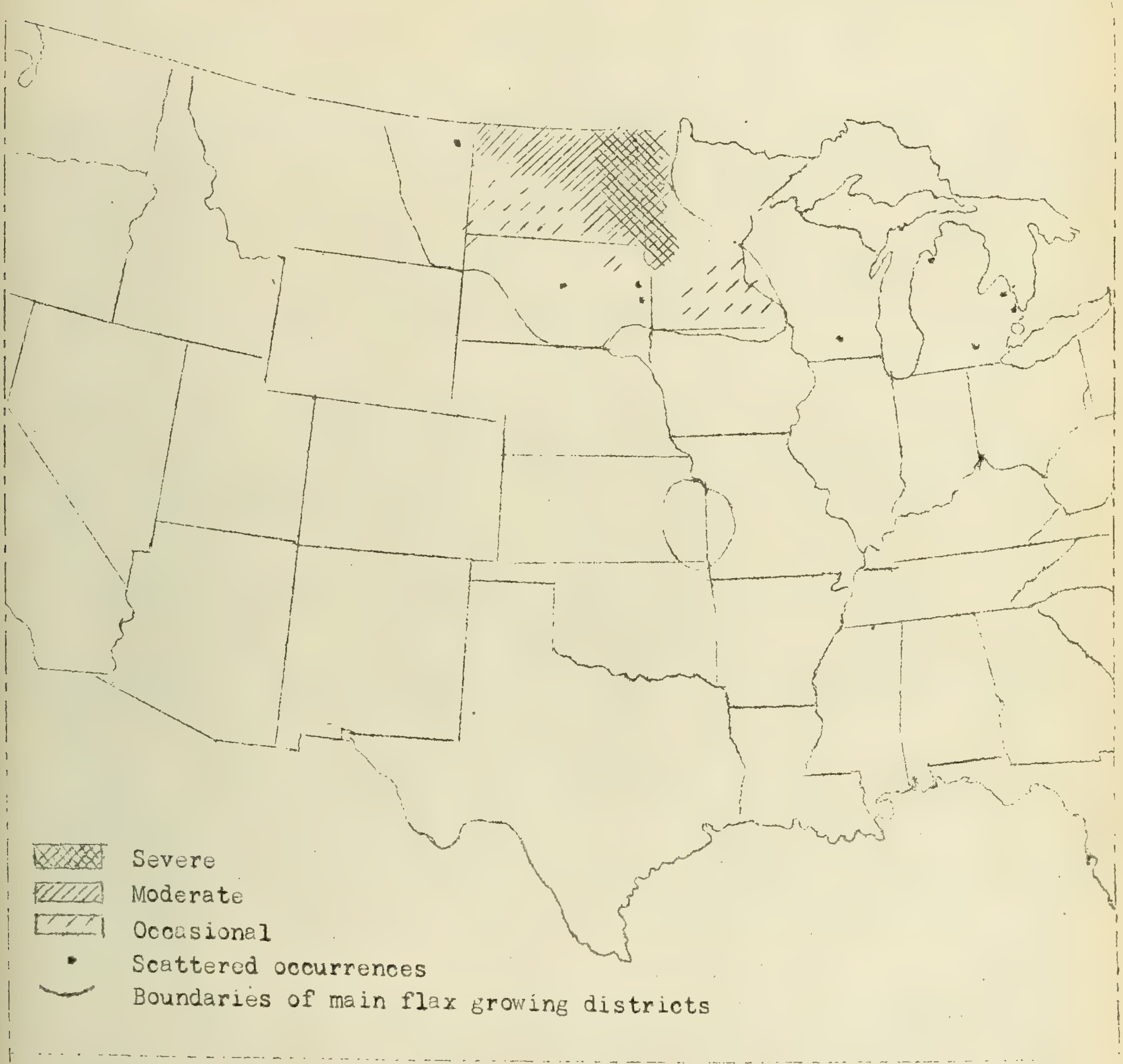


Fig. 35, Occurrence of flax wilt (Fusarium lini) as shown by records in the Plant Disease Survey.

Canker (non-parasitic)

Canker, which has been shown to be due to high temperatures at the surface of the soil, was reported as present to a slight extent in Wisconsin and South Dakota and as much less than in 1919 in North Dakota. W. E. Brentzel first noted canker at Fargo on June 16, following high temperatures on June 13 when a soil thermograph registered a temperature of 120° F. during a period of about two hours (Cereal Courier 12: 207, July 10, 1920). It was found in the flax survey as reported by Brentzel (Cereal Courier 12: 275. Aug. 20, 1920) at places in Minnesota, North Dakota, and Montana. It was found to be more severe in Montana and western North Dakota than in other places, as much as 50% damage being found in a large commercial field at Havre, Montana.

Rust caused by *Melampsora lini* (Pers.) Desm.

Flax rust was reported from Michigan (at East Lansing on breeding plots, first report for the state according to Coons), Minnesota, and North Dakota. It was not very prevalent in Minnesota and caused only very slight loss. In North Dakota it was reported by Bolley as general, and as usual, with an estimated loss of about 1%. In the flax survey, previously referred to, it was reported by Brentzel as severe in eastern North Dakota with as much as 100% in some fields, and as present in all fields in the Red River Valley to a greater or less extent, depending considerably upon the variety of flax grown. No rust

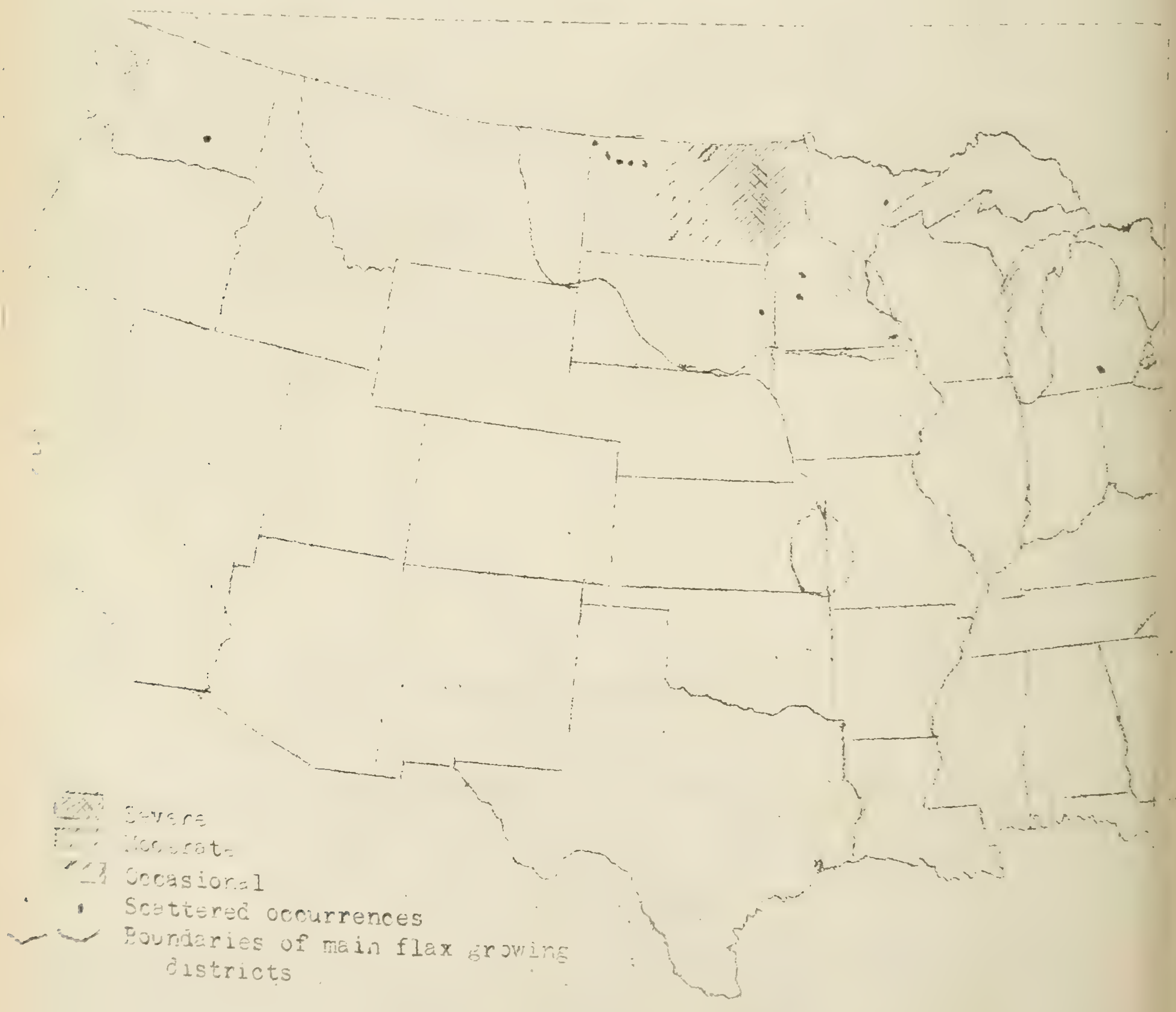


Fig. 36. Occurrence of flax rust (*Melampsora lini*) as shown by records of the Plant Disease Survey.

was found in North Dakota west of Dickinson and none was found in Montana. The occurrence of flax rust in 1920 and previous years, as reported to the Plant Disease Survey is shown on the accompanying map.

Anthracnose caused by *Colletotrichum lini* Bolley.

C. S. Reddy reports the occurrence of anthracnose on flax at three points in Michigan - East Lansing, Yale, and Peck. In the plots at East Lansing the percentage of affected plants ranged from less than 1% in some to more than 60% in others, while in the commercial fields the percentage ranged from less than one to five. A type of canker was produced in many cases.

SORGHUM

Covered kernel smut caused by *Sphacelotheca sorghi* (Link) Clinton.

The covered kernel smut of sorghum was reported in 1920 from Ohio (one collection), Missouri (one report), Texas (prevalent, 1% loss), New Mexico (slight), and California (prevalent).

Loose kernel smut caused by *Sphacelotheca cruenta* (Kühn) Potter.

This smut was reported from Alabama, Texas, and New Mexico. It was found in Alabama on the University farm, not serious. In Texas it was said to be prevalent, causing .5% loss, and in New Mexico was slight.

Head smut caused by *Sorosporium reilianum*(Kühn) McAlp.

Head smut of sorghum was reported as fairly prevalent in Texas (2% loss), and slight in New Mexico and California. The following statement by Melchers, with reference to the disease in Kansas, is quoted from the Cereal Courier 12: 329. Sept. 30, 1920.

> "Many inquiries are coming into the Station for treatment to prevent sorghum smut. Fields examined show more kernel smut than usual. The head smut has been showing in unusual and most alarming quantities at Hays, Kansas, in some experimental plots."

Other diseases.

Bacterial blight caused by *Bacillus sorghi* Burr. The bacterial blight was reported only from Iowa on sorghum and occurred there only as a trace.

Leaf spot caused by *Colletotrichum lineola* was reported by Edgerton as of considerable importance in Louisiana as a leaf spot and head blight. The percentage of affected plants in different fields ranged from 1-100 and the loss for the state was estimated as 1-5%.

FORAGE CROPS

A. LEGUMES

ALFALFA

Leaf spot caused by *Pseudopeziza medicaginis* (Lib.) Sacc. This disease was reported as very general in Vermont (5-7% loss), New York, New Jersey, Virginia, Maryland (2.5% loss), West Virginia, Tennessee (2% loss), Georgia (2% loss), Ohio, Indiana, Iowa (2% loss), and Idaho. It was also present in Pennsylvania, Colorado, Washington, Oregon, and Arizona (common in southern part of the state and causing considerable loss which is difficult to estimate because of the presence of bacterial disease).

Yellow leaf blotch caused by *Pyrenopeziza medicaginis* Fckl. - reported as general and destructive on experimental farm at State College, Pennsylvania, as common but not serious in Idaho, and one record in 1920 in Washington.

Leaf blight caused by *Ascochyta imperfecta* Pk. This disease together with bacterial blight was said to be doing much damage in New Mexico.

Leaf spot caused by *Pleosphaerulina briosiana* Pol. - was reported from one locality in Minnesota. This is the first report of the occurrence of this disease in Minnesota. It was first reported from Kansas in 1914 and records are on hand also from Wisconsin (1915) and Georgia (1915 and 1916).

Leaf spot caused by *Cercospora medicaginis* E. & E. - reported from Texas (unimportant).

Downy mildew caused by *Peronospora trifoliorum* de Bary - reported from Arizona, Idaho, Washington, and Oregon. Injury was slight.

Rust caused by *Uromyces medicaginis* Pass. - reported from Texas as important only under dry conditions.

Bacterial blight caused by *Bacterium medicaginis* Sackett was reported from New Mexico, Arizona, Idaho, and Washington. It was most severe in the Southwest. L. H. Leonian (New Mexico) comments as follows: "The alfalfa stem spot is doing much damage here this year. It occurs with *Ascochyta imperfecta* and between the two alfalfa does not have much chance." J. G. Brown examined one field near Tucson, Arizona, in which 40-50% of the plants were affected.

Yellows (non-parasitic) - reported from Tennessee as less prevalent than in 1919.

White top, cause undetermined, "may be a mosaic", was reported from Maryland.

Root rot caused by *Phythium debaryanum* Hesse - was reported from Missouri (one county).

Root rot caused by *Ozonium omnivorum* Shear - Texas (very important especially under irrigation. Loss .5%).

Violet root rot caused by *Rhizoctonia crocorum* DC. - reported by Hopkins from Andrew County, Missouri as root rot caused by *R. medicaginis*, but from the description "roots covered with dull reddish mycelium", it seems evident that violet root rot was present.

Root rot caused by *Sclerotinia trifoliorum* Eriks. - reported from Washington and Oregon (apparently more than last year, 10% found in one field. First noticed March 24, at Grant's Pass. Prevalent in western Oregon.)

Root knot caused by *Heterodera radicicola* (Greef) Müll. - reported from Texas. The disease was said to be unimportant owing to the fact that all varieties except the Hairy Peruvian (which is apparently resistant) have been discarded.

Dodder (*Cuscuta* spp.) - reported from Tennessee, Texas, and Washington.

CLOVER

(White clover, Trifolium repens; red clover, T. pratense;
alsike clover, T. hybridum; crimson clover, T. incarnatum)

Anthracnose caused by Colletotrichum trifolii Bain was reported from Kentucky, Tennessee, Ohio, and Indiana. In Kentucky it was severe on crimson clover causing a loss of 80% in one field. In Tennessee the loss was said to be less than some years ago owing to the general use of Bain and Essary's variety, Tennessee Resistant Red. The earliest recorded appearance was May 24 in Kentucky and May 28 in Indiana.

Anthracnose said to be caused by Gleosporium caulivorum Kirch. was reported from West Virginia, Ohio, Wisconsin, Minnesota, and Iowa. It caused appreciable damage on red clover in the vicinity of Madison, Wisconsin.

Bacterial leaf spot caused by Bacterium sp. This disease has recently been described by L. R. Jones and Maude M. Williamson as occurring in Wisconsin, and apparently widely elsewhere, on red clovers, both Trifolium pratense and T. medium. The organism overwinters in the crown or bud and dissemination is chiefly by spattering water. Progress of infection is most rapid in moist weather in spring, summer, and fall, and is checked by dry heat. (Bacterial leaf spot of red clover. Abstract Phytopath. 11: 50. 1920).

Leaf spot caused by Pseudopeziza trifolii (Bernh.) Fckl. Reported from New York, Pennsylvania, West Virginia, Ohio, and Minnesota.

Leaf spot caused by Macrosporium sarciniforme Cav. was general in fields in Pennsylvania and Arkansas. It was also reported from Minnesota and Missouri. In the latter state it was associated with rust in causing severe injury to red clover on continuous clover plots.

Sooty spot caused by Phyllachora trifolii (Pers.) Fckl. - reported on red clover from West Virginia, on clover from Tennessee and Vermont, and on red, white, and alsike clover from Minnesota.

Powdery mildew caused by Erysiphe polygoni DC. was reported from West Virginia and Washington.

Rust caused by Uromyces fallens (Desm.) Kern was reported on red clover from Pennsylvania, West Virginia, Minnesota, and Washington. It probably occurred very generally as usual. In Pennsylvania it was said to apparently cause considerable damage at times. F. L. Duley reported this rust as severe, causing death of the plants, on continuous clover plots in Missouri.

Rust caused by Uromyces trifolii (Hed.) Lev. was reported generally on white clover with slight or no injury, also on alsike clover from Pennsylvania and Minnesota.

Mosaic (cause unknown) was reported from Arkansas as general, injuring 25% of the crop. C. R. Orton has supplied the following note with reference to observations on this disease in Pennsylvania:

> "For several years the writer has observed a pronounced mosaic disease upon the common species of cultivated clovers, Trifolium pratense, T. repens, T. hybridum, and T. incarnatum. Upon all these plants the disease has the typical mosaic symptoms with the chlorotic streaks pronounced. Usually it appears to be systemic and atrophy is commonly an accompanying symptom. No severe cases of the disease have come to my attention upon the red, white, and alsike clover, but in May, 1919, my attention was called, by the Extension Pathologist, E. L. Nixon, to a serious trouble of crimson clover on a farm near Chambersburg, Pennsylvania. Specimens brought in were found to show very pronounced mosaic symptoms. Most of the plants were in the dwarfed stage and not more than a 50% crop was harvested from a 7-acre field."

Gray mold caused by *Botrytis* sp. - reported as slight in one locality in Pennsylvania.

Stem rot, cause unknown, apparently associated with nematode injury, was reported by Hungerford as common and destructive in the Twin Falls section of Idaho.

Wilt caused by *Fusarium* sp. - This disease, which appears to be new, was reported by Selby as known from three counties in Ohio in 1920.

Root rot caused by *Sclerotinia trifoliorum* Eriks. - observed locally on clover in Kentucky (near Louisville), Tennessee (east), Ohio (Montgomery County), Washington (Snokomish County), and Oregon (worse, damage general, 50% in one field. Observed first February 10, Douglas County).

Nematode disease caused by *Tylenchus dipsaci* (Kühn) Bastian. This disease was again very severe in the Twin Falls section of Idaho. In a number of fields infection was so severe that it was necessary to plow them up. G. H. Godfrey also reports finding this disease in western Oregon, in non-irrigated sections, on strawberry and clover, and in Washington and Utah. It was rather severe in parts of the latter state.

A. J. Pieters, of the U. S. Department of Agriculture, visited the clover seed district in the Yakima Valley of Washington in the summer of 1919. In this section, where about 2,000 acres of red clover are grown for seed, he found evidence of nematode in every field examined. Specimens were sent to Dr. Ralph Smith of the Idaho Experiment Station who positively identified the nematode as *T. dipsaci*.

Dodder (*Cuscuta* spp.) on clover was reported from New Hampshire, Tennessee, and Arkansas.

VETCH

Root rot caused by *Sclerotinia trifoliorum* Eriks. was reported from Tennessee as the first record for that state on vetch. Only one previous record, from North Carolina in 1916, of occurrence on this host has been received by the Plant Disease Survey.

Blight caused by *Ascochyta pisi* Lib. - reported from Michigan as severe in Charlevoix County.

SWEET CLOVER

Ascochyta caulicola Lau. - reported on sweet clover from Michigan.

Root rot caused by *Sclerotinia trifoliorum* Eriks. was reported from Washington, Pierce County.

Root rot caused by *Fusarium* sp. occurred in experimental plots at Knoxville, Tennessee.

COWPEA

Leaf spot caused by *Cercospora cruenta* Sacc. was general in New Jersey, Arkansas, and Texas, also one report from Missouri. The disease was said to be very important in Texas causing early shedding of the leaves.

Leaf spot caused by *Phyllosticta phaseolina* Sacc. was noted in one field in Indiana causing distortion of the pods. Fifty percent of the plants were affected.

Rust caused by Uromyces appendiculatus (Pers.) Lev. was generally distributed on cowpea in Texas, as in 1919, but was said to occur late in the season and hence caused little loss.

Mosaic (cause unknown) was noted as quite widely scattered in Arkansas and as extremely severe in large fields.

Wilt caused by Fusarium sp. - reported from one locality in Arkansas.

Root rot caused by Ozonium omnivorum Shear was a very important disease in Texas and caused a loss estimated at 5%.

Root knot caused by Heterodera radicicola (Greef.) Müll. - generally present in Arkansas.

SOYBEAN

Bacterial blight caused by Bacterium glycineum Coerper and B. sojae Wolf - According to I. V. Shunk and F. A. Wolf (Soybean bacterial blight. (Abstract) Phytopath. 11: 52. 1921) these two organisms are distinct and both are pathogenic to soybeans causing a similar type of injury. The latter organism only has been found associated with blight in North Carolina. Soybean blight was also noted in 1920 to occur in Louisiana, Indiana, and Michigan. The disease was of moderate importance in Louisiana and Indiana.

Mosaic (cause unknown) was reported by C. R. Orton from Pennsylvania on soybean as follows:

> "On July 30, 1920, a field of Ito San soybeans was inspected at Girard, Erie County, and in this field the writer first observed mosaic upon soybeans. About 2% of the plants were affected, and most of them only on the top, showing the condition often found in tomatoes and tobacco when the plants become infected late in the season. The symptoms were pronounced - even more so than is usually seen in red and alsike clover. In fact this mosaic is as pronounced as one often sees mosaic upon tobacco."

VELVET BEAN

Leaf spot caused by Bacterium sp. (probably Aplanobacter stizolobii Wolf) was reported as of moderate importance in Louisiana.

HORSE BEAN

Sun scald (non parasitic) practically destroyed the crop of horse beans on the college farm in Idaho according to Hungerford.

B. GRASSES

SUDAN GRASS

Bacterial blight (Red spot) caused by Bacillus sorghi Burr. was reported by Goss as prevalent on experimental plots in Nebraska.

Kernel smut of sudan grass was reported from Nebraska by Goss: "Experimental plots on the college farm show considerable infection of kernel smut."

MISCELLANEOUS GRASSES

Since most of the data on diseases of grasses consist only of records of occurrence it seems best to list them in tabular form under the causative fungi as follows:

RUSTS

- Puccinia coronata
  - Avena fatua - Minnesota
- Puccinia epiphylla
  - Poa canadensis - Minnesota
  - Poa pratensis - Minnesota
- Puccinia glumarum
  - Hordeum jubatum - Idaho
- Puccinia graminis
  - Agropyron caninum - Minnesota
  - Agropyron repens - Minnesota, New York, Vermont
- Puccinia graminis (cont.)
  - Agropyron tenerum - Minnesota
  - Agrostis palustris - Minnesota
  - Avena fatua - Minnesota
  - Elymus canadensis - Minnesota
  - Elymus robustus - Minneosta
  - Hordeum jubatum - Minnesota
  - Phleum pratense - Maine, Tennessee, Ohio, Michigan, Minnesota, Iowa, Idaho

SMUTS

- Urocystis agropyri
  - Elymus sp. - Minnesota
- Ustilago bromivora
  - Bromus sp. - Idaho
- Ustilago crameri
  - Chaetochloa lutescens - Minnesota
- Ustilago lorentziana
  - Hordeum jubatum - Minnesota
- Ustilago neglecta
  - Chaetochloa lutescens - Minnesota
- Ustilago rabenhorstiana
  - Syntherisma sanguinalis - Minnesota
- Ustilago striaeformis
  - Poa pratensis - Minnesota
  - Phleum pratense - Pennsylvania, Iowa, Minnesota, Idaho.

MISCELLANEOUS

- Claviceps paspali
  - Paspalum sp. - Arkansas
- Claviceps purpurea
  - Agropyron caninum - Wisconsin, Minnesota
  - Agropyron repens - Wisconsin, Minnesota
- Claviceps purpurea (cont.)
  - Agropyron smithii - Wisconsin, Minnesota
  - Agropyron tenerum - Wisconsin, Minnesota
  - Agrostis palustris - Wisconsin
  - Arrhenatherum elatius - Wisconsin

Claviceps purpurea (cont.)
- Bromus condensatus - Idaho
- Bromus inermis - Wisconsin, Minnesota
- Calamagrostis canadensis - Wisconsin, Minnesota
- Calamagrostis sp.-Minnesota
- Dactylis glomerata - Wisconsin, Minnesota
- Elymus canadensis - Wisconsin, Minnesota
- Elymus virginicus - Wisconsin, Minnesota
- Festuca elatior - Wisconsin
- Festuca sp. - Minnesota
- Hordeum jubatum - Wisconsin
- Hordeum nodosum - Minnesota
- Lolium sp. - Idaho
- Panicularia fluitans - Wisconsin
- ~~Phelum~~ Phleum pratense - Wisconsin, Minnesota
- Poa compressa - Wisconsin
- Poa pratensis - Wisconsin, Minnesota
- Stipa viridula - Minnesota

Colletotrichum cereale
- Beckmannia erucaeformis - Minnesota

Epichloe typhina
- Calamagrostis canadensis - Minnesota
- Elymus robustus - Minnesota

Erysiphe graminis
- Agropyron repens - Minnesota
- Hordeum jubatum - Minnesota
- Poa pratensis - Minnesota

Phyllachora graminis
- Agropyron repens - Minnesota
- Calamagrostis canadensis-Minnesota
- Elymus canadensis - Minnesota
- Elymus striatus - Minnesota
- Elymus virginicus - Minnesota
- Hystrix patula - Minnesota
- Oryzopsis asperifolia - Minnesota

Piricularia grisea
- Chaetochloa italica - Ohio

Rhynchosporium secalis
- Bromus inermis - Wisconsin
- Dactylis glomerata - Wisconsin

Sclerospora graminicola
- Chaetochloa italica - Minnesota
- Chaetochloa lutescens - Iowa
- Chaetochloa viridis - Iowa

Scolecotrichum graminis
- Hordeum jubatum - Idaho
- Phleum pratense - Idaho, Minnesota
- Poa compressa - Minnesota
- Poa triflora - Minnesota

Sporotrichum sp.
- Poa pratensis - Iowa

C. MISCELLANEOUS

SUN FLOWER (Helianthus)

The cultivation of sunflower as an ensilage crop has become quite important recently in certain sections; especial interest is, therefore, attached to the diseases of this crop.

Wilt caused by Sclerotinia sp.

Sunflower wilt was reported in 1920 from Montana, Washington, and Oregon, also from Manitoba by Bisby. According to Morris and Swingle (H. E. Morris and D. B. Swingle. An important new disease of the cultivated sunflower. (Abstract) Phytopath. 11: 50. 1921) the disease appeared at several points in Montana and attacked plants at all stages of growth. In one field 24% of the plants were killed by this disease, and within a month there was an increase of 22%. The disease was reported from Oregon in 1920 by H. P. Barss as follows:

"Worse than last year and worse than average year. Threatens to become serious in the moist coast section as sunflower silage industry grows. Twenty percent of affected plants were found in one field. The disease causes death of plants at any stage from attack near the ground."

Heald and Dana report it from four counties in Washington - Whatcom, Snohomish, (two localities), Kitsap, and Whitman. It was reported from Minnesota, Ramsey County (first record). G. R. Bisby reports this disease as well distributed over Manitoba and states that in addition to sunflower, certain composite weeds, such as Iva, Canada thistle sowthistle, and wild sunflowers are found killed in the field by this disease (Sclerotinia disease of sunflower in Manitoba. Phytopath. 11: 49 1921). Previous records of this disease in the files of the Plant Disease Survey show it to have occurred at Puyallup, Washington in 1912 and 1919, also in Yamhill County, Oregon, in 1916. The identity of the disease in the different sections is as yet uncertain. The disease as it occurs in Washington has been described by Lawrence (W. H. Lawrence. Plant Diseases induced by Sclerotinia perplexa nov. sp. Washington Agri. Exp. Sta. Bul. 107: 1-22. 1912) and the organism ascribed to a new species (Sclerotinia perplexa Lawrence. Lawrence states that the disease was quite severe on sunflowers in western Washington in 1909 and 1910 and that the same fungus also occurred on quite a number of other plants including thousand-headed kale, Jerusalem artichoke, marrow cabbage, onion, and others.

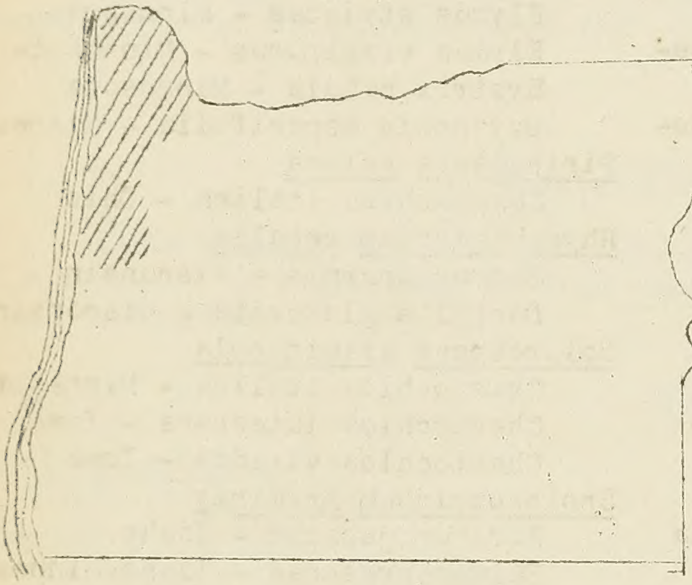


Fig. 37. Occurrence of Sclerotinia disease of sunflower in Oregon in 1920, according to H. P. Barss.

Other diseases.

Rust caused by Puccinia helianthi Schw.,although reported only from New Jersey, Michigan, and Minnesota was no doubt general over the country.

Soft rot of head (cause probably bacterial) - reported from Georgia as causing considerable loss in silage plants. It caused a rotting of the heads and shattering of the seeds.

Powdery mildew caused by Erysiphe cichoracearum DC. was reported from Iowa, Minnesota, and Washington.

Botrytis blight caused by Botrytis sp. was reported as rather prevalent in the coast sections of Oregon according to H. P. Barss. The fungus attacked the leaves, growing tips, and heads.